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New Series, Vol. IX
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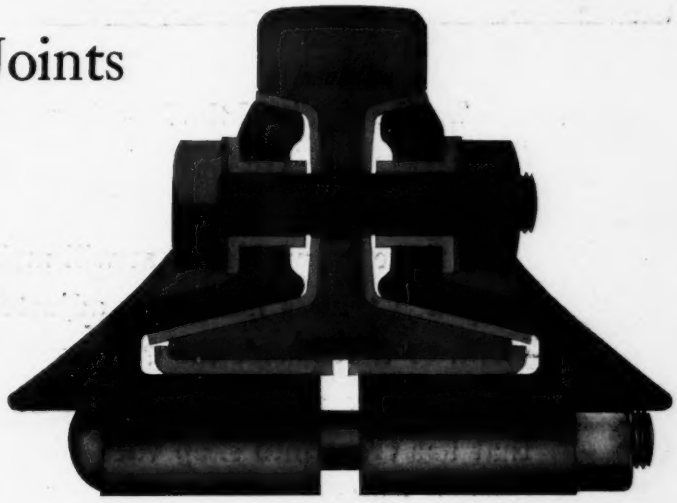

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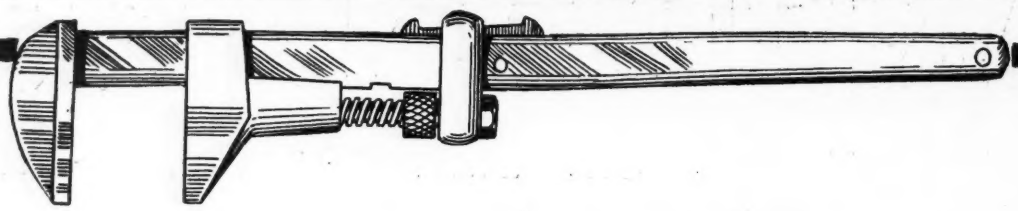

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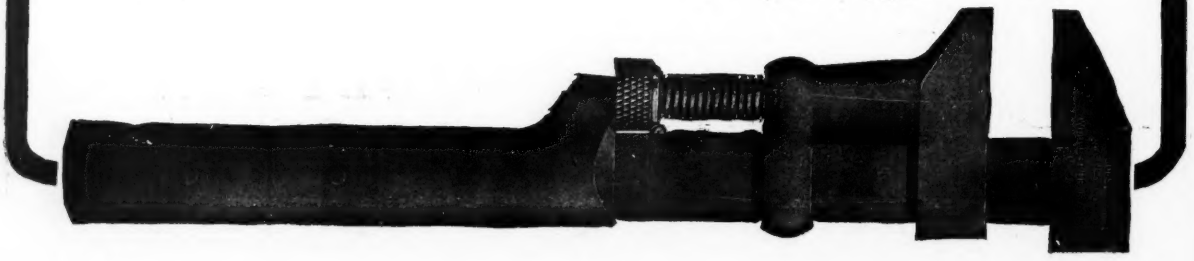

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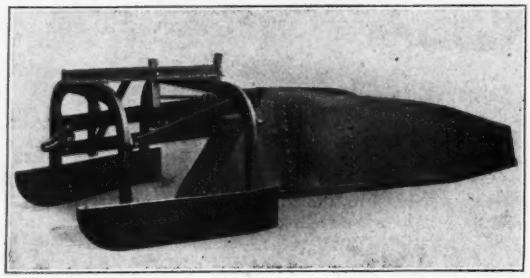

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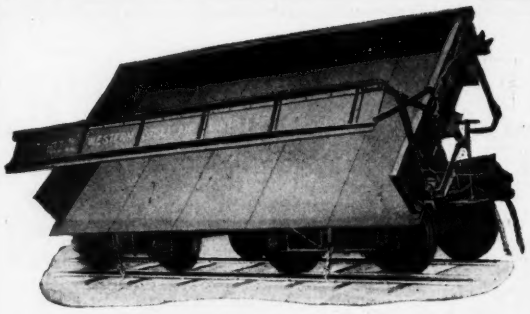

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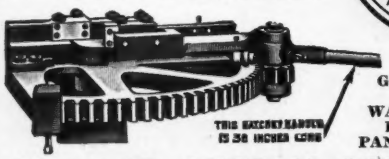

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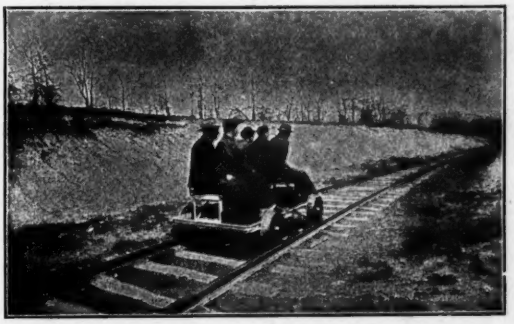

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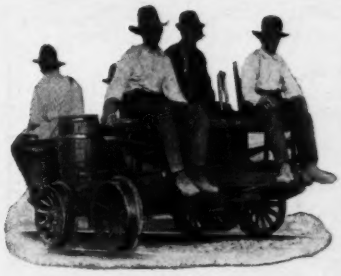

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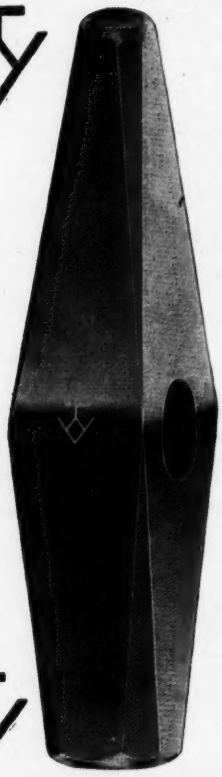

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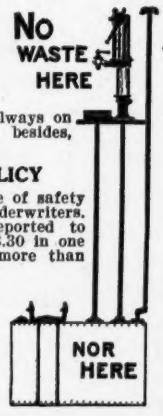

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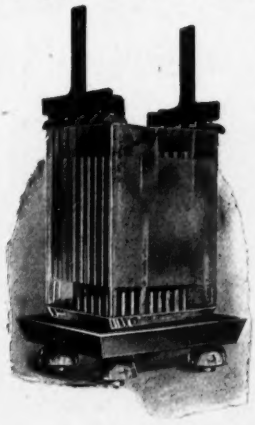

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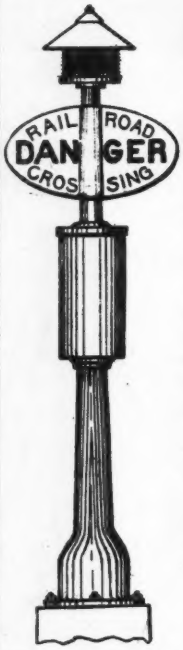

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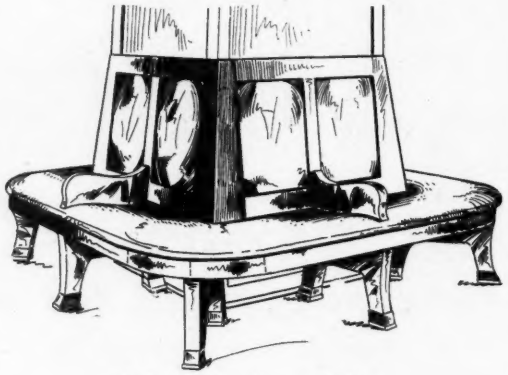

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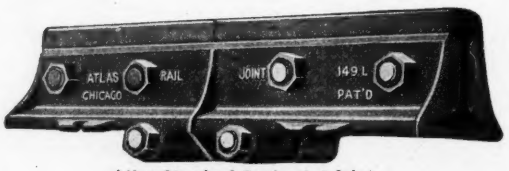

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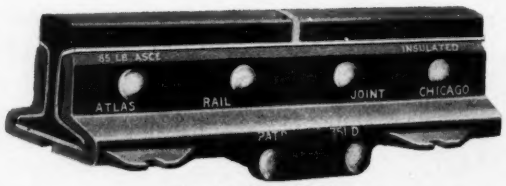

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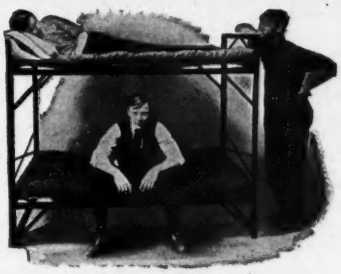

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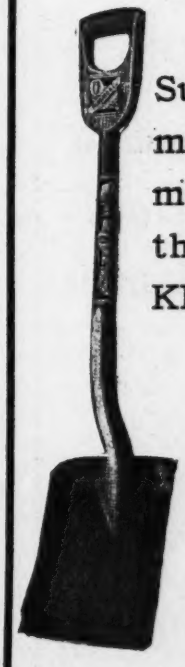

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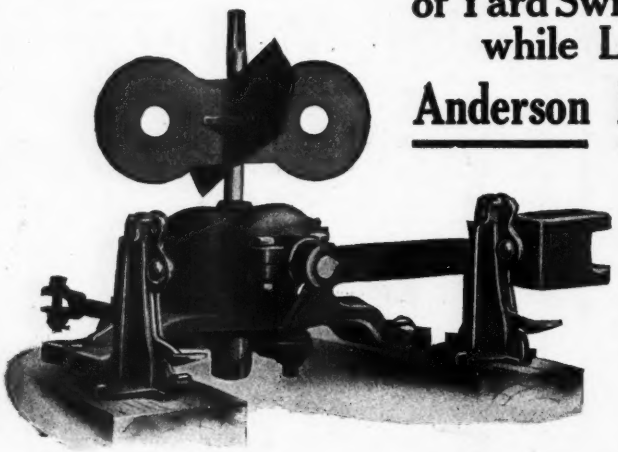

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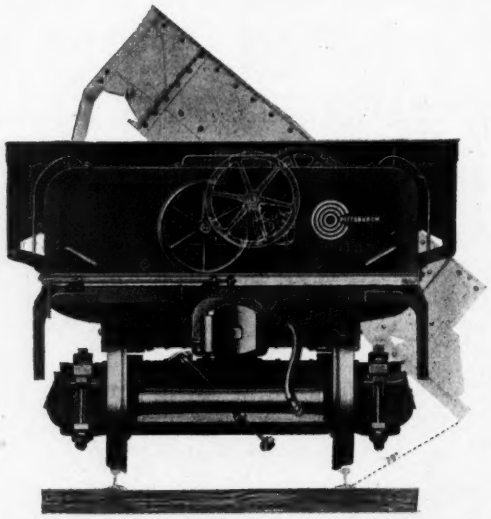

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New Series, Vol. 9
Old Series Vol. 28
Chicago, August, 1913
No. 8

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Effect of Curtailed Receipts on Wages.

MANY MEN in railway work become discouraged at the slow advancement which they seem to be making. And there is undoubtedly some justice in this feeling, as applied to certain men. But there are many general adverse conditions which should be taken into account by the employe at this time.

While prices of all commodities have increased greatly within the last few years, the railways have been denied increased freight rates, the argument being that they were unnecessary, and that great economies could be effected in operation. The latter is true only in a limited sense—the present facilities may be made more efficient, but that means heavy initial expense. Anyone familiar with the money market knows that until very recently it has been almost impossible to float bond issues for improvements such as grade revisions, efficient terminals, and terminal facilities, in which great economies now can be effected. To make the machine really effective does not mean only to save hundreds of dollars in the shops when thousands may be saved by changing operating conditions.

There is a story of a manager of an industrial concern who had made a reputation as a very economical manager, and he was hired by a board of directors which did not think its business was making enough profit. At the end of one year the manager made a report which showed a great saving in postage and office expenses, but the entire plant had operated at a deficit. By his excessively economical methods he had driven away business.

Railway officials realize the importance and are willing to make improvements which will reduce operating expenses. But they need capital to accomplish such things, and it has not been forthcoming at rates which would make the improvements possible.

In addition, the public's demand for better service, better stations, and cheaper fare, has made a great inroad on the capital which has been obtained.

The committee on railway mail pay has submitted figures to show that, far from being overpaid, the railways are being underpaid $15,000,000 for carrying mail. It has long been argued that there is a great deal of space used under the present method of handling the mail on trains for which the railways do not but should have pay. Is this pay not reasonable if such space is necessitated by the mail service?

A new expense which is now becoming necessary is the work of valuating railway property. Such valuation is not required in all states, but is in some. Legislation, in fact, is constantly saddling railways with new expenses, many of them for just and necessary improvements and safety devices, but the same legislative bodies refuse higher rates to meet such increased expenses, and those called for by constantly increasing scales of wages. It therefore devolves upon railway managements to meet all these increased expenses somehow out of receipts which come from a reduced passenger fare rate, and a freight rate without increase. The stockholders demand, and most of them are entitled to a fair rate on the investment, and fixed charges must be met.

Is it any wonder, then, that railways find it inexpedient, or impossible to raise wages as fast as many employes seem to deserve?

There are, of course, some ways in which a more equitable distribution may be made, and this is true of some railways more than others. It is frequently a fact that the conductor of a work train on construction is paid more than the engineer or roadmaster in charge of the whole work. Is this equitable? And again, favorites of certain officials, and officials with a "pull" frequently receive salaries greatly in excess of their value to the company. If such salaries were cut to the proper figure, much money would be available to raise the wages of real producers.

The employe, however, can do much to accomplish two very desirable conditions, viz.: (1) by economizing and carefully planning work he can reduce operating expenses; (2) by talking, voting and writing he can gradually help to change public opinion and obtain increased receipts, and a more lenient feeling towards his railway.

The Safety Movement

R. C. RICHARDS, of the Chicago & North Western, has recently issued a statement of results gained through the comprehensive campaign of safety inaugurated on his system several years ago. Far seeing officers who authorized the expenditure of what may have been considered comparatively large sums in safety education of employes, are amply rewarded by the showing presented.

During the three years ending June 30, 1913, and based upon the number of accidents occurring during the year ending June 30, 1910, there was a decrease in the number of employes killed of twenty-eight per cent; and in the number of injured, of twenty per cent. In the total number of persons killed, including employes, passengers, and outsiders, there was a decrease of twenty-one per cent. In the same classification the number of injured was reduced twenty-four per cent.

It is probable that a part of this showing should be credited to the adoption of safety appliances not directly attributable to the safety first movement. Nevertheless, there can be no doubt but that the startling results represent an almost direct return on the safety first policy of the management. And the end is not yet. The efforts thus far are merely preliminary. The movement will grow as the men are further educated in the necessity for the use of great care and the elimination of the element of chance.

Short Tangents Between Curves.

A SHORT tangent should never be located between two curves turning in the same direction. It is extremely hard to line the short tangent and is practically impossible to ever line so that it will not appear to have a swing. The appearance of imperfection should be sufficient to condemn the practice.

Another objection is that the super elevation must be run out, and then immediately run back in again, producing track which is somewhat harder to maintain, and also providing two places for a jerk of the equipment when going over the track at high speed.

Where the tangent is short, practically the identical location could be utilized by compounding the curve once; but even if it was necessary to use several degrees of curvature, the extra trouble of figuring and staking out is highly advisable from the track man's standpoint.

The tendency of the curve to get out of line at the point, in the direction of traffic, furnishes still another objection. By compounding the curve and eliminating the short tangent, two points of curve would be eliminated from the track.

Howard Elliott

FOR THE second time in their respective careers Howard Elliott succeeds Charles S. Mellen as the president of a large railway system. In each case the desirability of a complete change of executive policy has been the impelling motive in the selection of Mr. Elliott. Two men of more widely different dispositions, yet with the qualifications of a railway president, could scarcely be found.

As to the results of the application of the Mellen policies in New England there is little to say. He is recognized as a most efficient organizer, a most confident exponent of what he believes to be right, and a most arbitrary executive in putting into effect his personal wishes. Whether on account of, or in spite of these characteristics, he leaves active railway service in New England a most cordially hated man.

The position of the railway executive is becoming year by year more difficult. The public is, at best, fickle in its attitude toward an important individual and the tactful and frank executive could probably have carried out all of Mr. Mellen's policies and still have held the good will of the people. The necessity for taking (or at least seeming to take) the public into his confidence in all matters pertaining to the operation of a great railway, is hard for a representative of the "old school" to realize.

Mr. Elliott is wonderfully successful in holding this good will in every move. His statements are gems of diplomacy and by his methods he is enabled to give the public larger pills to swallow than the arbitrary man could ever hope to "put over."

It is with great pleasure that we note Mr. Elliott's expressed intention of making no changes in his department heads until the absolute necessity of such action becomes evident. A statement of one of the directors of the New Haven system, before the selection of Mr. Elliott was to the effect that a thorough cleaning out of the present officers was contemplated. This move would have been as foolish as many others which collectively have placed the road in ill repute. Doubtless there will be changes but, if we judge rightly, they will take place only after Mr. Elliott has had opportunity to pass judgment on the qualifications of the present incumbents as he finds them.

THE POETRY OF RAILROADING.

The oft quoted Finnigan has a rival in Pat Donohue, an Ohio freight conductor whose train had a breakdown recently. After the accident he sent this message to train dispatcher Straight:

Two-twenty-two has a busted flue. What shall I do.
Donahue.

This awakened the slumbering muse in the telegraph office, and the reply ran:

Wait. Two-twenty-eight will take your freight.
Dispatcher Straight.
—*Exchange.*

Mississippi River Bridge at St. Paul, C. G. W. R. R.

On April 21 the Chicago Great Western R. R. opened to traffic its new Mississippi River bridge at St. Paul. This single track structure consists of 7 deck plate girders of 79 ft. span, center to center of end bearings, and one Waddell & Harrington vertical lift Pratt truss span, 192 ft. center to center of end pins, which when raised will give a clear height of 55 ft. above the water. On the south end there is 170 ft. of temporary pile trestle, and on the north end 220 ft.

The abutments (or rather the end piers) are thus located in the water and not at the edge of the river. They are, however, located where it is expected the future harbor bulk head line will be.

The alignment on the south bridge approach and on the seven deck plate girders is tangent. The north approach, however, is on a 10 degree curve, which connects with the general bridge tangent at about the second panel point from the north, on the truss span. It is interesting to note that the center line of the truss span does not coincide with the general bridge tangent, but is at a slight angle, which gives the best average position of the tracks with both the tangent and the curve at the north. The track is level on the plate girder spans, has an 0.8 per cent grade on the truss span and a 1.0 per cent grade on the north approach.

Lift Span Lowered.

Lift Span Raised.

Six of the piers under the girders are located on a 16 degree 48 minutes skew, corresponding to the probable future harbor line. The lift span piers are skewed 1 degree, 22 minutes, 33 seconds in the opposite direction, to correspond to the general direction of the channel.

The new bridge replaces an old 412-foot draw span and three 225-foot through truss spans, the location of which is shown in the general plan, all built in 1885 and reinforced in 1901, and on account of its light design and the increased weight of rolling stock it had to be replaced with a stronger structure.

Substructure.

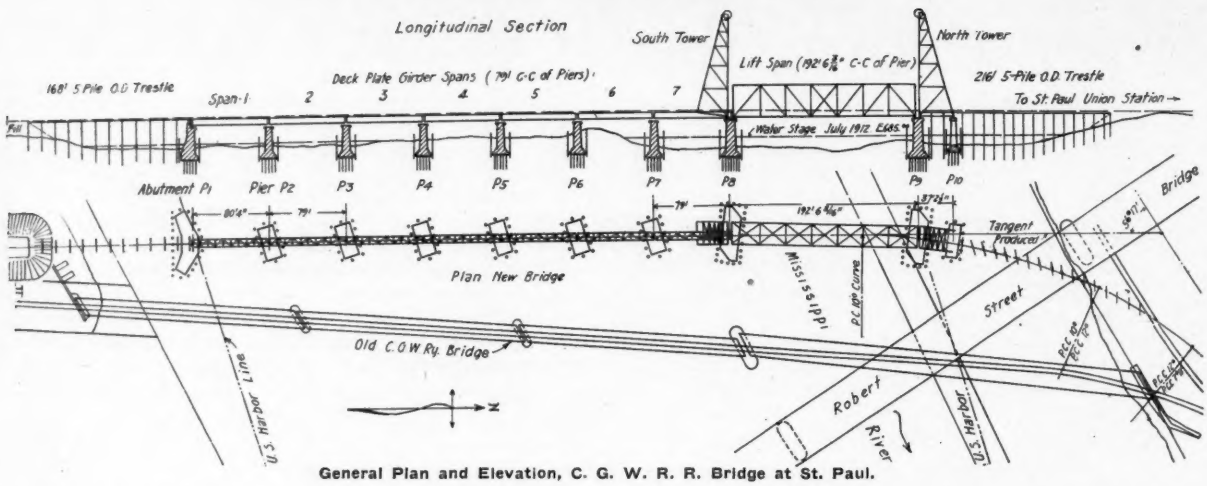
The six plate girder piers, abutment, two truss span piers, and the two small rest piers (on the north end), are all of plain concrete masonry, with a few bars added in bridge seats and footings as an additional precaution to take care of unequal loads or settlements.

Piers 2 to 6 inclusive, are of the same dimensions, the plan and elevation being shown herewith. The footings, 34 ft. wide, 16 ft. thick, and 31 ft. 3 ins. high, are supported by 60 piles, with penetrations of 15 to 20 ft., the piles penetrating and being supported by the river sand. The arrangement of the bars is somewhat unusual. As shown in the pile plan, these square bars are located in pairs, longitudinally and transversely, just above the rows of piles, i. e., 9 ins. above base of footings. The square bars in the bridge seats are located on 1 ft. 3 in. centers transversely and longitudinally, 1½ inches from the top of pier. The batter on up-stream nozing is the same as on the down-stream face, 1 in 12. The nosing consists of an old rail, base outward, anchored by stirrups, as shown in the detail.

Pier P-7 is similar to piers P-2 to P-6, but is 5 ft. higher. The footings have same dimensions, but the batter is changed to give the same width at top, with the extra 5 ft. height.

The abutment pier P-1 has two symmetrical wings with 27 ft. 5 in. faces, and the face is 13 ft. 5 ins. wide at base. The pier is 17 ft. 5 ins. thick at the bottom, 41 ft. 4¼ ins. high, and has nine equal offsets at the back, giving a thickness of 7 ft. under coping. The back wall is of plain concrete, built monolithic with the pier. The reinforcing is similar to that on the other piers, in the pier footings proper; but few bars are used in the wing footings. The dotted lines show provision for future extension if the banks are built out to the pier, which will then become an abutment.

The piers, P-8 and P-9, under the truss span, are similar in shape and general dimension, with the exception of the height. The height of pier P-8 is 46 ft. 6¼ ins. and of pier P-9 is 38 ft. 6 ins., the total batter being 1 ft. 4 ins. in each one, which left the other dimensions the same. The piles supporting these piers are spaced 2 ft. 3 ins. transversely, and 2 ft. 9 ins. longitudinally. In addition to the table showing bill of reinforcing bars, the pile plan specifies the number and lengths of bars



General Plan and Elevation, C. G. W. R. R. Bridge at St. Paul.

in detail in such a manner that the placing is made very easy.

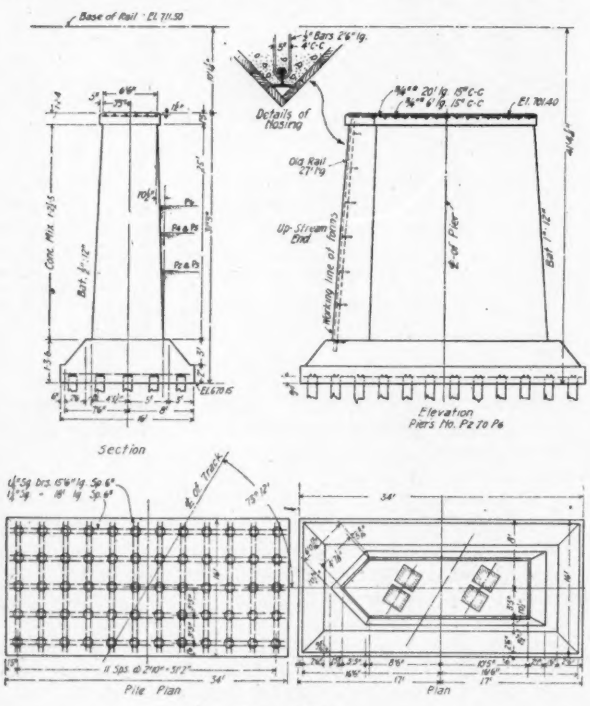
The rest pier for the hips at the north end of the lift span is an interesting design showing considerable economy of material. The two parts of this pier are tied together by bars in the footing similar to that in the other piers, by 4 transverse rails near the top of the footing, and by a reinforced concrete beam at the top of pier. The top of the peculiar shaped footing is just below the river bed, giving the appearance of two separate piers. The connecting slab is 3 ft. deep and 1 ft. 6 ins. wide with four 1¼ in. square bars on 4 in. centers, top and bottom. It is planned to make an abutment around these twin piers if the harbor line is moved to this point. Concrete mixtures were as follows, using pit run gravel and sand: Footings, 1:3:6; body of piers, 1:2½:5; coping, 1:2:4.

Superstructure.

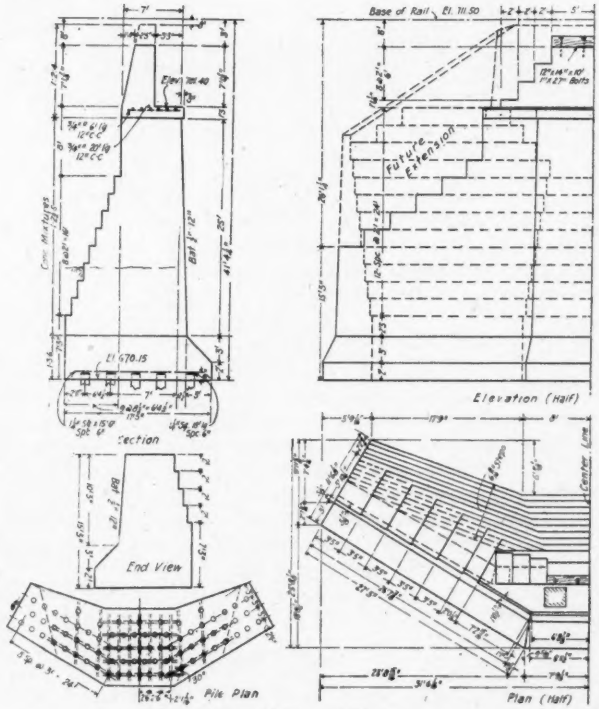
The loadings assumed in design were: Dead load, total weight of metal in the structure plus 500 lbs. per lineal foot for the floor, which included rails, rail fastenings, ties, and guard timbers; live load Coopers E. 55 load, with the exception that a following load of 5,000 lbs. per lineal foot was used instead of 5,500 lbs. per lineal foot. The impact allowance was

$$I = S\frac{300}{L \pm 300}$$

when S = computed maximum live load strain, and L = loaded length which produces the maximum stress in the structure. Wind pressure was considered at 30 lbs. per square foot of exposed surface with bridge loaded, and 50 lbs. per square foot when not loaded. A centrifugal force of 4½ per cent of the moving load, per degree of curvature, was used in designing the truss span. No impact is allowed, under the specifications, for longitudinal, centrifugal, lateral, or wind forces. Tension allowed was 16,000 lbs. per square inch net section; compression $16{,}000 - \frac{l}{r}$, with a maximum of 14,000 lbs. per square inch, gross section; shear, 12,000 lbs. per square inch, shop rivets and pins, and 10,000 lbs. per square inch for field rivets, turned bolts, and net section of plate girder webs.



Typical Pier.



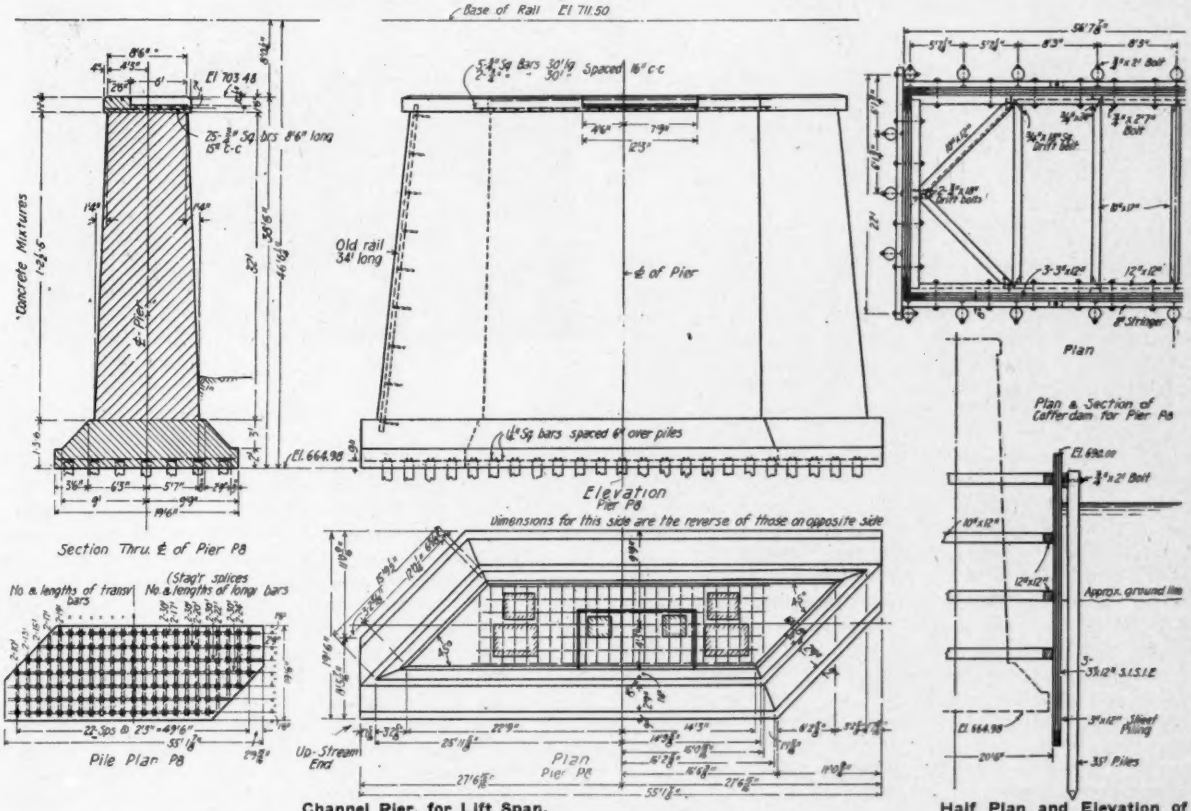
South Abutment-Pier.

The plate girders, except the end ones, are exactly similar, and have 79 ft. spans with ends skewed at 16° 48 min. The web plate is 90 x $\frac{7}{16}$ in., with a top flange of four 6 x 6 x $\frac{3}{4}$ in. angles (spaced 12 in., back to back) and a bottom flange of two 8 x 8 x $\frac{3}{4}$ in. angles. The bottom flange has one cover plate 18 x $\frac{5}{8}$ x 61 ft. 9 in., one 18 x $\frac{5}{8}$ x 50 ft. 9 in, and one 18 x $\frac{5}{8}$ x 36 ft. 6 in. The top has two plates extending across the entire span, and in addition two plates 10 x $\frac{7}{16}$ x 44 ft. 9 in, and two 10 x $\frac{7}{16}$ x 34 ft. 3 in., riveted vertically to the sides of the 6 in. angles, and between the backs of these angles, which are 12 in. back to back. The depth of girder is 7 ft. 5¾ in. back to back of angles. The lateral bracing is in 5 panels, top and bottom. The lower diagonals are 4 x 4 in. angles, the six central diagonals being $\frac{3}{8}$ in. and the four end diagonals being $\frac{7}{16}$ in. thick. The top six diagonals at the center consist of two 3½ x 3½ x $\frac{3}{8}$ in. angles with legs down, and four end ones are made up of two 5 x 3½ x $\frac{3}{8}$ in. angles with the legs down. Each strut in top and bottom consists of a 3½ x 3½ x $\frac{3}{8}$ in. angle.

The lift span is a single track 189 ft. Pratt truss, with the added members at the end for the lifting attachments. The lift span is suspended by eight wire ropes at each corner, which lead over the sheaves at the tops of the towers and are connected to concrete counterweights, balancing the span. The operating machinery is carried on top of the lifting span at the center, and consists of four grooved drums actuated through a train of gears by electric motors. Each drum controls two operating ropes; one rope leading from the top of the drum passes over a deflecting sheave at the adjacent corner of the span, thence downward and is fastened near the bottom of the tower; and the other rope leading from the bottom of the drum, passes under a deflecting sheave at the adjacent corner of the span, thence upward and is fastened near the top of the tower. All four drums are similarly connected, and when they are revolved in one direction the ropes leading to the tops of the towers are wound on the drums, and those connected to the bottoms of the towers are payed off, thus raising the span by the lifting force exerted on the corner sheaves. Reversal of direction of revolution of the drum lowers the span. Brakes with automatic stops control the movement of the span and a hand brake is provided for manual control. The span may also be operated by hand power.

Construction.

The excavation was made in cofferdams. The cofferdams, contrary to ordinary practice, had the piles on the exterior of the sheeting. The details of the cofferdam construction are shown in the accompanying half plan and section. The arrangement of the piling was to make it easier to withdraw piles, allow easier and better interior bracing and permit the bottom portion to be used as forms for the concrete footings.


Base of Rail El 711.50
El 703.48
Concrete Mixtures
25-¾" Sq bars 8'6" long 15" c-c
Old rail 34' long
℄ of Pier
El. 664.98
Elevation Pier P8
Section Thru ℄ of Pier P8
Dimensions for this side are the reverse of those on opposite side
No. & lengths of transv bars
(Stagr splices) No. & lengths of long bars
22 Spcs @ 2'3" = 49'6"
Pile Plan P8
Up-Stream End
Plan Pier P8
Plan
Plan & Section of Cofferdam for Pier P8
Approx. ground line
3-35 1/2" S.I.S.I.E
3"x12" Sheet Piling
35' Piles

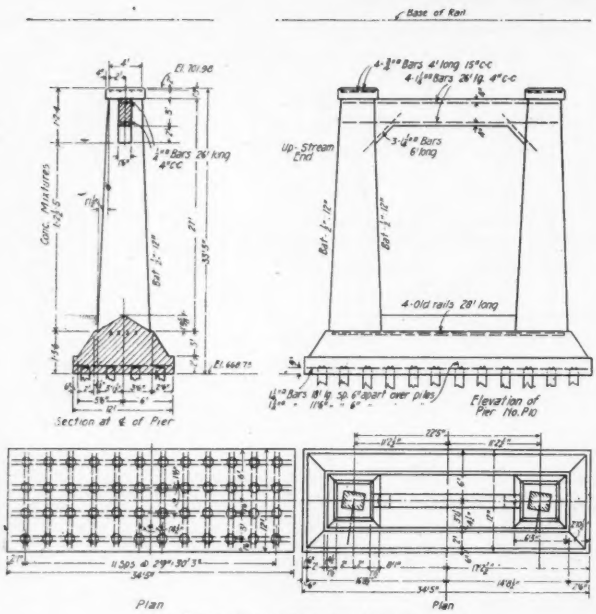
Channel Pier, for Lift Span.

Half Plan and Elevation of Coffer Dam.

The excavations for the piers were started and carried down at least half the depth before placing the cofferdams, using an orange peel bucket. The pile driver then started driving the piles at the outer girder pier P-8, and worked backward toward the bank. The driving was in river sand, containing a portion of quick sand, and was very hard. The preliminary excavation helped materially in increasing the speed and facility of driving. A traction driver was used on the south, the water being only about 3 ft. deep. The channel piers were driven by a driver located on a barge.

Blow-ins were encountered early in the work, and a unique method was used to remedy the difficulty. It was at first thought that a second cofferdam would have to be built outside the first, as two pumps could not lower the water, bags of sand being carried through the blow-in into the dam. A canvas skirt was made and placed over the pier, designed to spread out and cover the bottom all around the dam. Sand bags were then placed in quantities and it was soon possible to pump out the dam with only one pump.

The concrete plant was located on Rasberry island. Sand,



Auxiliary Rest Pier for Lift Span.

gravel and cement were unloaded from the old bridge into bins below the bridge; in the winter the sand and gravel was dropped onto perforated boxes, containing perforated steam pipes, through which live steam was pumped to heat the aggregates before mixing. Sand was unloaded on one side of the old bridge pier, and gravel on the other, the materials being unloaded through bottom dump cars through holes cut in the bridge decking. The mixer was located only a few feet away, and the aggregates were wheeled in on wheelbarrows. Concrete for footings and all concrete below river level was placed under water with a bottom dump bucket. The aggregates were kept hot enough so that the temperature in the cofferdams never got below 40 deg. before setting, although part of the concrete was placed in 12 deg. below zero weather. The upper parts of piers were filled from cars operating on a narrow gauge track outside the piers. The car bodies held 1 yd. each, and the bodies were lifted off the tracks and concrete dumped by derricks. The piers were housed in with wooden houses, with about 3 ft. between the pier neat line and the walls. These houses were kept hot with salamanders and no concrete was frozen on the entire job. In fact, the concrete work is excellent, giving no indication whatever that it was put in during freezing weather.

The girders were placed by derricks working on the new track. Two girders were placed and decked, and the track laid across the span, after which another span was built and the operation repeated. Only eleven days were required to place the girder spans—about 1½ spans per day—an excellent record. The lift span was erected on false work in 28 days.

The quantities involved in the work were: Steel, 925 T.; concrete (exclusive of counterweights), 3,572 yds.; piling, 31,200 lin. ft.; cofferdams, 406,000 ft. B. M.; excavation, 5,500 cu. yds.; counterweights, 225 tons.

The substructure was done by contract by the Widell Company and the superstructure by the American Bridge Company, all under the direct supervision of Mr. L. C. Fritch, chief engineer. Mr. C. Chandler was engineer of bridges, M. D. Thompson was assistant engineer of bridges, E. M. Lewis, engineer in charge, and H. H. Edgerton assistant engineer. We are indebted to L. C. Fritch, chief engineer; W. R. Roof, assistant engineer of bridges of the Chicago Great Western R. R., and to C. C. Chandler, formerly bridge engineer of the Chicago Great Western R. R., for the data and illustrations contained herein.

BRIDGE AND FLOOD DESTRUCTION IN CALIFORNIA.

By Henry Grattan Tyrrell, C. E.

March of 1907 was a month of destructive floods in many parts of the western and southwestern states. It was then when more than 100 miles of railroad in Nevada were seriously injured, and nearly half that amount was totally destroyed in Meadow Valley. Similar floods visited many parts of California, and especially the valleys of the Sacramento, San Joaquin and Salinas rivers. As the writer at that time was connected with some of the western roads, and personally visited, examined and photographed many of the flooded districts, some illustrations and notes pertaining to flood destruction in these regions are herewith given.

In order to appreciate the flood possibilities of California, it should be remembered that the state, which is the second

The Flood Season.

largest in the Union, is 200 miles wide and nearly 800 miles long, and on account of its mountainous character it enjoys the greatest diversity of climate. While summer warmth may prevail at the seashore, the mountains only a hundred miles away are covered with perpetual snow. A traveler may enjoy sea bathing in the morning at San Francisco, and before night he may be up on the mountain summits in a freezing atmosphere. This varied climatic condition is responsible for the common expression in California: "If you don't like the climate then go across the street."

The great central drainage valleys lying between the Sierra Nevada and Coast Ranges are coursed by the Sacramento and San Joaquin rivers, flowing from the north and south respectively, which, after passing the delta lands to the west of Stockton and Sacramento, empty into San Francisco bay. These great central valleys of California, walled in by mountains on both sides, and watered from the everlasting snow, are among the most fertile and productive regions of the world. It is there that the big redwood trees are found, some of which, forty feet in diameter and 350 feet in height, have been declared by scientists to be not less than 8,000 years old.

Small Regulating Works on the Sacramento River.

Tehema Washout.

The normal rainfall of about twenty inches per year all comes during the six months from November to April, with little or none in summer, and no corresponding damage risk to crops, but the spring floods are often very severe. The Sacramento river from the north is fed chiefly by the Pitt river from Goose lake and the Feather river from many mountain streams, as well as a great many other streams, large and small, from the ranges to the east and west. Travel on the line from Portland to San Francisco is heavy, not only because of the agricultural products, but because of its fine scenery. On the northern part of the road Mount Shasta stands out plainly against the sky, its summit reaching to a height of 14,400 feet above the sea. Timber growth ceases at a height of 7,000 to 8,000 feet, and at 10,000 feet is perpetual snow. In the vicinity of Shasta Springs, Dunsmuir and Castle Crags, where the railroad is 2,500 feet above sea level, the wonderful scenery has caused the erection of summer cottages on a plateau 500 feet above the tracks.

In the spring of 1907, melting snow from rising temperature and heavy rains caused much of the delta lands east of San Francisco to be under water. From Tehema southward, the valley is served by two lines of railway, on the east and west sides of the Sacramento river.

On March 18th washouts in several places south of Tehema on the east branch to Roseville put that line out of service for twelve days, and Portland trains were then run wholly on the west branch through Davis and Woodland. Two days later other floods closed the whole Shasta line. One of the worst breaks occurred near Castella, 320 miles north of San Francisco, where the track was washed out in a dozen places, in lengths of 400 to 500 feet. At one place the engine of a derailed freight train was thrown into the river and swept 300 feet down stream by the force of the current, which must have been running at tremendous speed. This occurred at a bend in the river where the water swept in against the railroad bank, cutting it all away. A temporary trestle was speedily built between the old line and the adjoining hills, and a wagon road was made through the woods and around the washout, for the transfer of passengers and baggage, work being carried on both day and night. For the permanent rebuilding of these banks, loose rock was not obtainable, and it was blasted from the adjoining cliffs. A box car at one place was taken several hundred feet down stream, and it appears in one of the views with its wheels in the air. Trains were run to the washouts, and passengers were taken by wagons over corduroy roads through the woods to the other side of the break. Several of my photographs show the cargo being unloaded and taken in this way past the wrecked road.

Washout on the Sacramento River South of Tehema. Inverted Flat Car Partly Submerged.

The rush of water from all directions to San Francisco bay caused great damage in the delta region from Sacramento south to Tracy. On March 20th a washout 3,000 feet long and five to ten feet deep occurred at Webster just west of Sacramento, and several smaller ones in the vicinity were 300 to 400 feet long, and ten to fifteen deep. This put the main eastern line out of service, and trains were then detoured around to the south by way of Tracy and Stockton, but a few hours later the line was washed out in several places between Stockton and Lodi. The next day banks went out between Tracy and Lathrop and trains from San Francisco to the east were then sent around to the south by way of Mendota and Fresno, but after two days, when repairs were made near Lodi, travel was resumed through Tracy, Lathrop and Stockton. Other washouts and landslides on March 24th closed the line between Niles and Tracy for two or three days, but on March 31st another landslide in Sunol canyon again stopped travel on that branch for two days more. Stockton and Sacramento, both cities of about 30,000, are busy centers, and especially the former, which is at the head of ocean navigation, and traffic interruption was serious. The line from Tracy to Stockton and Sacramento crosses many streams from the Sierras and is not over 20 to 30 feet above sea level, the small slope from there to the Pacific causing much back water.

Valley Line. Track Too Low For Security Against Floods.

During the same time, damage was being done on the line east to Reno. On March 18th a washout 300 feet long occurred at Floriston where a little stream runs south to Lake Tahoe, and another at Verdi, 150 feet long, where the track elevation is 4,900 feet. The next day landslides occurred at Eder and Cisco, covering the tracks for 200 feet, but it was opened again within twenty-four hours. On March 21st a fill 200 feet long and 30 feet deep at Appelgate went out, but it was repaired before nightfall of the same day. It had been there for forty-two years. At Donner lake, the highest point of the Sierras which the railroad crosses, where track is 7,017 feet above sea level, the snow was twenty feet deep in many places, and when the vast area so covered is considered the source of the

floods is evident. Donner lake, which is three miles long and 500 feet deep, was named from the Donner party, all of whom died there of starvation in the gold days. At Cape Horn, near the summit, the track is 1,000 feet above the adjoining valley. This flood destruction made San Francisco inaccessible by rail from March 20th to 25th, notwithstanding its many railway connections.

In southern California, heavy rains were experienced during the first week of March, and on the 5th instant several washouts occurred on the line to the south of San Bernardino mountains, just north of the Mexican border, and a bridge near Imperial Junction was destroyed. On the same day a landslide covered the track about thirty miles north of Los Angeles, and two weeks later, on March 20th, all travel on the Southern Pacific to the north from Los Angeles was stopped for three days by a washout near Pernando tunnel. During repairs the Southern Pacific northbound trains used the tracks of the Santa Fe north from San Bernardino, and around by Barstow and Mojave. On the following day (March 21st) 300 feet of embankment northeast of Saugus Junction near tunnel 23 was undermined by water and sank five to six feet.

Other flood destruction occurred farther to the north in the valleys of the San Benito and Salinas rivers. On the Santa Cruz branch east of Monterey bay, five landslides occurred on March 18th, on the river section between Watsonville and Aromas, and on March 20th a portion of the road just east of Betabel sank four feet, all of which closed the Coast line until March 26th, when it was opened as far south as Serrano. On March 19th tunnel No. 6, on the loop north of San Luis Obispo, caved in for a length of 125 feet while a freight train was passing through it, and buried four oil cars, which again blocked the Coast line. A second slide in the same tunnel occurred four days later and it was not opened again until April 12th.

While all of the simultaneous flood destruction could not be photographed immediately, much of it was examined and noted by the writer during the spring and summer of 1907, when it was at its worst, and the photographs show very fully the general character of the injured railways.

Active measures are now under way for controlling floods in the Sacramento valley at a prospective cost of over $30,000,000, which places the undertaking among the very largest of its kind in any country.

Twenty Years Ago This Month

Twenty years ago a contract for block signals on the New York Central & Hudson River between North Buffalo Junction and Suspension Bridge was given to the Union Switch and Signal Co. This contract covered interlocking plants at North Tonawanda and at North Buffalo. The latter plant was to have seventy levers.

An important convention in session during the month was that of the New England Roadmasters' Association.

At a largely attended meeting of the Buffalo Association of Railway Superintendents held July 15, 1893, W. L. Derr, then a superintendent of the Erie, and now a superintendent of the Chicago Great Western, read a paper on "Rail Joints." He gave a history of the evolution of the fish plate and reviewed the practice of several roads. He went on record as favoring a suspended six-bolt joint of the angle type with holes instead of slots for spikes.

[Note—In reference to the above item Mr. Derr expresses himself as follows: "Replying to your favor 15th inst., re holes instead of slots for spiking joint splices, and the use of suspended joints: I still hold to the opinion expressed in 1893 on the subjects referred to. The lateral pressure on rails in action is better resisted by four spikes than by two and the four spikes can be brought into play only by wholly surrounding them with the metal of the plate. Of the supported joint I can but say that its advocates, if any, forget about wave of deflection. There are two railroad appliances which, it seems to me, have not much improved in design over the original—locomotive boilers and rail joint splices. I shall not attempt to discuss the boiler further than to say a reading of Holly's American and European Railway Practice, published in 1861, Dredge's fine report on the transportation exhibits at the Chicago World's Fair, 1893, and the present practice in boiler design show I'm not far astray in my reference to boilers. Now, as to rail joints: Whether Bridges Adams invented the fish plate, or the Erie railroad was first to use the angle splices, as sometimes asserted by historians of the subjects, matters little from a joint design standpoint. This much may be said, however, very little improvement has been made over the angle splice idea, and so long as bolts remain the practically only means of fastening plates to the rails, it is doubtful whether much improvement will be made, for, after all is said, we cannot get away from the fact that the joint as a whole is no stronger than its fastenings. The defect of a joint fastening—assuming it to be in perfect condition—is that it lacks the power to transmit the wave deflection from one rail to the next. Two primary causes operate to bring about joint deflection—want of stiffness of the joint itself, and want of stiffness in the mode of attaching the plates to the rail. The first objection can be overcome by giving the plate sufficient depth, but the second is not so easily handled, because we have to fasten the plates to the rails by means of bolts, and up to date no one has succeeded in designing a bolt that will not loosen under the hammering of heavy trains. It follows, then, that no increased depth of plate is of much avail unless accompanied by some better method of fastening than bolting. The Patent Office records show that inventors have given this point much consideration, but, so far as I know, without success. I'm obliged to you for the reminder of Buffalo association days—days when Charlie Brunn, now general manager Buffalo Creek R. R., and Ed Knibloe, general agent same line, friend Ketchum, then of the D., L. & W., Tom Roberts, of the P. R. R., and many others of the boys, including myself, then of the Erie, got together once in a while and greatly enjoyed the occasion. Classic days, those! Yours truly, W. L. Derr."]

The Pennsylvania submitted plans for track elevation to the city council of Chicago. It was proposed to place all tracks on trestles.

Preparations were about completed for the eleventh annual convention of the Roadmasters' Association of America, which met in Chicago September 12, 13 and 14, 1893. The president was H. W. Reed, master of roadway of the S., F. & W. Ry., and the first vice-president was C. E. Jones, roadmaster of the C., B. & Q. Ry.

Geo. H. Bryant severed his connection with the Q. & C. Co. during the month and completed arrangements for representing in Chicago the Young Nut Lock Co., of New York. His office was at 468 The Rookery.

The Southern Pacific is said to be contemplating the building of a roundhouse and shops at Springfield, Ore.

The Pennsylvania has placed contracts for about 900 tons of structural material involved in small bridges. The business is divided among McClintic-Marshall Construction Co., Belmont Iron Works, Pennsylvania Steel Co., Eastern Steel Co., Cambria Steel Co. and L. F. Shoemaker & Co. This does not include a bridge at Braddock, Pa., which was awarded to the McClintic-Marshall Construction Co.

Terminal improvements are to be made in Philadelphia to include the removal of all grade crossings in South Philadelphia and a large increase to the port facilities, at an estimated cost of more than $18,000,000, as agreed upon recently at a conference between city officers and representatives of the railroads. The city's share will amount to $9,769,000; the Pennsylvania's, $7,057,000, and the Baltimore & Ohio's, $1,904,800.

Personals

Operating

J. T. King, formerly assistant to general superintendent of transportation, has been appointed general superintendent of transportation of the Atlantic Coast Line R. R., office at Wilmington, N. C.

R. N. Begien, who has been appointed general superintendent of the Baltimore & Ohio Southwestern R. R., as announced in the July issue of *Railway Engineering*, was born March 15, 1875, in Boston, Mass., but moved to Medford, Mass., when very young. He attended the public schools of Medford, and was graduated from the Medford High School in 1893, afterwards spending three years at Harvard College. He spent about five years in the service of the Nicaragua and Isthmian Canal commissions and in other government engineering services, including one year in the Engineer Department of the District of Columbia. In 1901 he was in Ecuador, South America, as assistant engineer on the Guayaquil & Quito R. R. for about nine months. He entered the service of the Baltimore & Ohio R. R. as assistant engineer on surveys for trunk line improvements August 8, 1902, under Mr. Francis Lee Stuart, at present chief engineer. In October, 1904, he took charge of the engineering office of the B. & O. at Morgantown, W. Va., and was transferred to Baltimore, under D. D. Carothers, late chief engineer, on special work, August 1, 1907. July 1, 1908, he was appointed division engineer at Philadelphia; October, 1909, acting engineer maintenance of way, main line system; April, 1910, assistant to chief engineer; December, 1910, assistant to general manager; April, 1912, assistant to third vice-president; December, 1912, assistant general superintendent, main line district, and July 1, 1913, general superintendent Baltimore & Ohio Southwestern R. R. at Cincinnati, O.

E. W. Scheer has been appointed superintendent of the Baltimore & Ohio Southwestern R. R. at Flora, Ill.

Alfred Price, formerly general superintendent, has been appointed assistant general manager of the Canadian Pacific Ry. at Montreal, Que. He entered the service of the Credit Valley Ry. in September, 1879. This road was absorbed by the Canadian Pacific Ry., on which Mr. Price held the position of car service clerk, stenographer and telegrapher for four years, train dispatcher for 5 years, chief train dispatcher and car distributor for 10 years, and superintendent for 5 years, all at Toronto. He was transferred to Fort William as superintendent for one year, and then was made superintendent of transportation, western lines, at Winnipeg, which position he held for three years. He was then made general superintendent, serving in this capacity on the Central division for one year, and on the Alberta division for 5 years, leaving the latter position to take up his present duties as assistant general manager.

D. C. Coleman, formerly general superintendent of the Manitoba division, Canadian Pacific Ry., has been transferred to Calgary, Alb., as general superintendent of the Alberta division, succeeding Alfred Price, promoted. E. M. Payne has been appointed superintendent of the Manitoba division, office at Winnipeg, Man., succeeding J. C. McMillan, appointed superintendent of telegraph. C. Murphy, formerly superintendent of transportation, has been appointed general superintendent of the Manitoba division, succeeding D. C. Coleman, transferred.

B. B. Greer, formerly superintendent, has been appointed assistant to general manager, Chicago, Burlington & Quincy R. R., lines east, office at Chicago, Ill. N. C. Allen, formerly assistant superintendent, has been appointed superintendent at Creston, Ia., succeeding W. A. Card, transferred to St. Joseph, Mo., succeeding B. B. Greer, promoted.

A. B. Warner, formerly superintendent, has been appointed general superintendent of the Chicago, Rock Island & Gulf Ry., at Fort Worth, Tex.

W. A. Sheahan has been appointed superintendent of the Chicago, Rock Island & Pacific Ry. at Colorado Springs, Colo., succeeding F. M. Patt.

J. Q. Van Winkle, formerly general manager, has been appointed assistant vice-president, Cleveland, Cincinnati, Chicago & St. Louis Ry., office at Cincinnati Ohio.

H. A. Worcester, formerly assistant general manager, has been promoted to general manager of the Cleveland, Cincinnati, Chicago & St. Louis Ry., office at Cincinnati, Ohio. He was born November 18, 1862, at Albany, N. Y., was graduated from Albany Academy in 1880 and then went to Yale College, from which he was graduated in 1884. On December 24, 1885, he became a clerk in the Depot Master's office at Grand Central station, New York, and resigned May 1, 1888. In August, 1889, he began as clerk in Superintendent Blodgett's office, Eastern division of the L. S. & M. S. Ry., Buffalo, N. Y., and in August, 1890, became assistant trainmaster on the Franklin division at Youngstown, Ohio. February 1, 1891, he was appointed superintendent of the Lansing division at Hillsboro; June 1, 1896, he was made superintendent of the Detroit division at Detroit; in November, 1902, he became superintendent of the Eastern division at Buffalo, and in February, 1905, he went to Chicago as superintendent of the Chicago division. In April, 1905, he was appointed assistant general superintendent of the Michigan Central R. R. at Detroit, and in November, 1905, became general superintendent. February 15, 1906, he was appointed general superintendent of the L. S. & M. S. Ry. at Cleveland, Ohio, and on October 1, 1906, became assistant general manager of the C., C., C. & St. L. Ry. at Cincinnati, which position he held till his present appointment was effective, July 10.

E. M. Costin, formerly superintendent, has been appointed assistant general superintendent of the Cleveland, Cincinnati, Chicago & St. Louis Ry., office at Indianapolis, Ind. T. J. Hayes, formerly trainmaster, has been appointed superintendent of terminals at Cincinnati, Ohio.

F. S. Elliott, formerly assistant general superintendent, has been appointed general superintendent of the Great Northern Ry. at Great Falls, Mont., succeeding C. O. Jenks, transferred to Superior, Wis., as general superintendent. Mr. Jenks succeeds J. H. Taylor, deceased. J. H. O'Neill, formerly division superintendent, has been appointed assistant general superintendent of the Great Northern Ry. at Spokane, Wash. J. Lindsay, superintendent, has been transferred from Sioux City to Melrose, Minn. John C. Sesser, formerly assistant engineer maintenance of way, has been appointed superintendent at Whitefish, Mont., succeeding W. R. Smith, who has been transferred to Everett, Mont., to succeed J. H. O'Neill, promoted. G. E. Votaw, for merly trainmaster, has been appointed superintendent at Sioux City, Ia., succeeding J. Lindsay.

Macy Nicholson has been appointed assistant general superintendent of the Great Northern Ry. at Great Falls, Mont. He began railway work in 1891 as clerk to superintendent, C. & N. W. Ry., at Ashland, Wis. In 1896 and till 1898 he was employed by the Rockefeller and United States Steel Mining Companies. From 1898 till 1902 he was clerk and chief clerk to the general superintendent, the vice-president, and the president of the Great Northern. He was appointed assistant superintendent in 1903, and superintendent in 1905, serving in the latter capacity on the Dakota, Butte and Fergus Falls divisions successively. His appointment as assistant general superintendent was effective July 20.

T. J. Lynch has been appointed general superintendent of the Greenwich & Johnsonville Ry., office at Greenwich, N. Y., effective July 1.

T. G. Banks has been appointed superintendent of the Houston & Brazos Valley Ry. at Freeport, Tex., succeeding C. A. Wood.

James Bain, who has been appointed general superintendent of the Halifax & South Western Ry., as announced in the July issue of *Railway Engineering*, was born at Pictou, N. S., May 24, 1860, and entered railway service May, 1875, since when he

has been, to March, 1876, operator, Intercolonial Ry., Truro, N. S.; March, 1876, to June, 1879, operator and ticket agent, same road, Stellarton, N. S.; June, 1879, to November, 1881, operator, same road, Truro, N. S.; November, 1881, to June, 1882, chief operator Western Union staff, Direct U. S. Cable Co., Tor Bay, N. S.; June, 1882, to April, 1886, dispatcher, Intercolonial Ry., at New Glasgow and Truro, N. S., and Moncton, N. B.; April to October, 1886, dispatcher, Missouri Pacific Ry., St. Louis, Mo.; October, 1886, to May, 1892, Chief Dispatcher, Quebec and Lake St. John Ry., Quebec, Que.; May, 1892, to November, 1899, Manager's Assistant, same road; November, 1899, to December, 1907, Superintendent, Q. & L. St. J. R., Lower Laurentian Ry., and construction of Great Northern Ry. of Canada, Quebec, Que.; December, 1907, to May, 1913, Superintendent, Halifax and South Western Ry., Bridgewater, N. S.

M. Dailey has been appointed general manager of the Muscatine North & South Ry., office at Muscatine, Ia., succeeding H. B. Holbert, resigned.

C. J. Field has been appointed general manager of the Orangeburg Ry., office at Orangeburg, S. C.

J. L. Brass has been appointed assistant to general manager of the Oregon-Washington R. R. & Navigation Co., office at Seattle, Wash. M. J. Buckley, formerly an assistant general manager, has been appointed general superintendent at Portland, Ore. W. Bollons, superintendent, has been transferred from Portland to La Grande, Ore. J. D. Stack has been appointed superintendent at Portland, Ore., succeeding Mr. Bollons.

R. K. Rochester, formerly division engineer, has been appointed superintendent of the Vandalia R. R. at Decatur, Ill., succeeding W. D. Wiggins.

J. BAIN, General Superintendent
Halifax & South Western Ry.

G. E. PATTERSON, Superintendent
Illinois Central R. R.

L. A. Downs, superintendent of the Illinois Central R. R., has been transferred from Ft. Dodge to Dubuque, Ia., where he succeeds W. S. Williams, transferred. G. E. Patterson has been appointed superintendent at Clinton, Ill., succeeding T. H. Sullivan, transferred to Ft. Dodge, Ia., succeeding Mr. Downs. W. S. Williams, superintendent, has been transferred from Dubuque, Ia., to Carbondale, Ill., succeeding J. J. Gavin, granted leave of absence.

C. F. Handshy has been appointed assistant general manager of the Illinois Traction System, effective June 1, office at Springfield, Ill. He began railway service as telegraph operator for the Wabash R. R. in 1884 and was promoted to the position of train dispatcher in 1890, which position he held until 1902, then being promoted to assistant chief dispatcher at Decatur, Ill. In 1904 he was promoted to chief dispatcher, and in 1905 to position of train master, leaving that position to accept service with the Illinois Traction System as general superintendent of transportation of interurban lines September 15, 1907. He was appointed to the position of general superintendent of interurban lines in January, 1910, which position he held till his appointment as assistant general manager, mentioned above.

L. S. Brown, formerly assistant superintendent, has been appointed superintendent of the Intercolonial Ry. of Canada at New Glasgow, N. S., succeeding Y. C. Campbell.

G. H. Hobbs, formerly vice-president and comptroller, has been appointed general manager of the Maine Central R. R., office at Portland, Me.

A. C. Maxwell has been appointed general manager of the Midland Continental R. R., office at Jamestown, N. D.

M. Bunker has been appointed vice-president and general manager of the Washington & Choctaw Ry. at Yellow Pine, Ala., succeeding S. M. Newcomb.

Engineering.

J. B. Cameron, formerly assistant engineer, has been appointed division engineer maintenance of way of the Baltimore & Ohio R. R. at New Castle, Pa. Claude Brown, assistant engineer, has been placed in charge of the Glenwood Bridge reconstruction under direction of Paul Didier, principal assistant engineer. Mr. Brown's office is at Glenwood, Pa. A. G. Beard, resident engineer, has been transferred from Garret, Pa., to Belleville, Ohio. P. A. Callahan, resident engineer, has been transferred from Wheeling, W. Va., to Columbus, Ohio. R. C. Howard has been appointed field engineer at Huntington, W. Va.

R. A. Cook has been appointed valuation engineer of the Chicago & Alton Ry., office at Chicago, Ill., effective May 18. He entered the service of this railway in June, 1903, as rodman, and was appointed assistant engineer in May, 1904, working in that capacity on both maintenance and construction till May, 1909. At that time he was appointed assistant engineer on track elevation, serving at Joliet and Chicago, and on other construction work in the vicinity until his promotion as mentioned above.

W. R. Roof has been appointed assistant engineer of bridges, Chicago Great Western R. R., office at Chicago. W. C. Harvey has been appointed assistant engineer of buildings, also with office

at Chicago. E. M. Lewis has been appointed assistant engineer at Chicago, succeeding Mr. Harvey.

F. D. Batchellor, formerly superintendent, has been appointed district engineer maintenance of way of the Cincinnati, Hamilton & Dayton Ry., office at Cincinnati, Ohio.

J. E. Fletcher has been appointed division engineer of the Erie R. R. at Meadville, Pa., succeeding F. D. Lakin, transferred to Huntington, Ind., succeeding C. J. Rist.

C. Chandler has been appointed assistant engineer of bridges and buildings of the Illinois Central R. R. at Chicago, Ill. H. Rhoads has been appointed assistant engineer at Chicago, succeeding W. G. Nusz.

J. E. Lockhart, assistant engineer on the Louisville & Nashville R. R., has been transferred from Montgomery, Ala., to Paris, Tenn., succeeding J. C. Haskins. J. E. Scott has been appointed assistant engineer at Montgomery, Ala., succeeding J. E. Lockhart.

W. C. HARVEY, Assistant Engineer Buildings
Chicago Great Western R. R.

G. H. Harris, formerly division engineer, has been appointed engineer of track of the Michigan Central R. R., office at Detroit, Mich.

John Evans has been appointed division engineer of the Michigan Central R. R. at Detroit, Mich., succeeding G. H. Harris, promoted, effective July 21. Mr. Evans graduated from Michigan University, civil engineering course, in 1904. He began work the same year with the Michigan Central R. R. as rodman, and was soon made instrument man. From 1905 to 1910 he was employed on the Detroit River Tunnel on alinement, inspection and electrical equipment work. In 1910 he was appointed assistant division engineer at Detroit, which position he held at the time of his appointment as division engineer.

C. E. Smith, formerly bridge engineer, has been appointed assistant chief engineer with duties temporarily as chief engineer, of the Missouri Pacific Ry., office at St. Louis, Mo. He was born in Somerville, Mass., in 1877, and was graduated from Massachusetts Institute of Technology in 1900, civil engineering course, having acquired considerable engineering experience previous to that date. From June to November, 1900, he was assistant city engineer of Putnam and Willamantic, Conn. He then entered the service of the New York, New Haven & Hartford R. R. as bridge designer. He left the service and was connected for a few months with the Bureau of Yards and Docks, Navy Department, Washington, D. C., as structural steel draftsman. He later re-entered railway work as assistant engineer on bridge erection and inspection with the Lake Shore & Michigan Southern Ry. In 1905 he was a text book writer for the International Correspondence Schools, and in 1906 and 1907 technical editor of the Structural Materials division, U. S. Geological Survey. He entered the service of the Missouri Pacific Ry. in 1907 as assistant engineer, maintenance of way, and was made bridge engineer in 1909, which position he held till his present appointment as noted above.

L. Craine has been appointed assistant engineer of the Missouri Pacific Ry. at St. Louis, Mo. H. A. Jones has been appointed assistant engineer at Wynne, Ark., succeeding H. R. DeWitt. C. S. Sample has been appointed assistant engineer at St. Louis, Mo. J. H. Vincent, assistant engineer, has been transferred from Illmo to St. Louis, Mo.

W. G. Bowen, division engineer of the National Rys. of Mexico, has been transferred from Monterey, N. L., to San Luis Potosi, S. L. P. J. C. Galbreath, division engineer, has been transferred from San Luis Potosi, S. L. P., to Guadalajara, Jal. E. Nelson, division engineer, has been transferred from Cardenas, S. L. P., to Tampico, Tamp. W. F. Curlin has been appointed division engineer and roadmaster at Tierra Blanca, Ver.

G. W. Boschke, formerly an assistant general manager, has had his title changed to chief engineer maintenance, of the Oregon-Washington R. R. & Navigation Co., office at Portland, Ore. J. R. Holman, formerly an assistant general manager, has had his title changed to chief engineer construction, office at Seattle, Wash. H. L. Lyon has been appointed division engineer at La Grande, Ore.

The headquarters of H. P. Bayly, assistant engineer of the Southern Ry., have been changed from Augusta, Ga., to Richmond, Va. His time is divided between Spencer, N. C., and Richmond, Va. He succeeds O. B. Lackey, promoted. L. C. Gilliam has been appointed assistant engineer at Birmingham, Ala., succeeding A. Harris, who has been transferred to Knoxville, Tenn., succeeding L. Sitton, promoted. H. H. Powell has been appointed assistant engineer at Washington, D. C.

H. A. Phelps has been appointed division engineer of the Southern New England Ry., office at Providence, R. I., succeeding T. I. Ellis, resigned.

W. M. Jaekel has been appointed division engineer of the Southern Pacific Co. at Bakersfield, Cal., succeeding A. T. Mercier, transferred to Los Angeles, Cal.

A. W. Galbreath has been appointed assistant engineer of the Vandalia R. R. at St. Louis, Mo. A. S. Bland, formerly division engineer of the Pennsylvania lines west, has been appointed division engineer at Decatur, Ill., succeeding H. C. Johnson, who has been transferred to Logansport, Ind. Mr. Johnson succeeds W. L. Ekin, transferred to Terre Haute, Ind., succeeding R. K Rochester, promoted.

P. Cain, formerly engineer maintenance of way, has been appointed division engineer of the Western Maryland Ry. at Elkins, W. Va. J. M. Harris has been appointed division engineer at Hagerstown, Md.

W. C. Kline has been appointed division engineer of the Western Maryland Ry., effective July 15, 1913, in charge of maintenance between Connellsville, Pa., and Williamsport, Md. He was graduated from Lehigh University in 1905, and was rodman and later instrument man for Pennsylvania R. R., East River Tunnels, New York, 1905-1907. He was instrument man and bridge inspector on the Western Pacific Ry. at Elko and Tulasco, Nev., 1907-1909, and masonry inspector Southern Pacific Co., of Mexico, located at Nacozari, Sonora, Mexico, 1909-1910. He was appointed resident engineer of the Western Maryland Ry., on construction of Connellsville extension, 1910-1913, which position he held till his appointment as noted above.

Bridges and Buildings.

J. M. Fitzgerald, formerly assistant engineer, has been appointed supervisor of bridges and buildings of the Central of Georgia Ry. at Macon, Ga., succeeding J. F. Clepper.

A. E. Bechtelheimer has been appointed assistant general inspector of bridges of the Chicago & North Western Ry. at Chicago, succeeding C. H. Perry, appointed general inspector of bridges.

Thomas Gardner has been appointed master carpenter of the Great Northern Ry. at Minot, N. D., succeeding J. L. Lemon.

S. C. Smith has been appointed supervisor of bridges and buildings of the Oregon-Washington R. R. & Navigation Co., at La Grande, Ore.

C. A. Redinger, formerly assistant engineer, has been appointed supervisor of bridges and buildings of the Southern Ry., at Knoxville, Tenn.

Protection of Concrete During Hot Weather.

IT IS NOT at all uncommon to hear prominent engineers say that concrete placed during periods of extreme hot weather is in general weaker than that placed in winter, if the materials are heated and the surface protected after placing. If it could be forcibly impressed on the minds of inspectors and contractors that protection of concrete surfaces from the direct rays of the sun during hot days is just as important as protection against cold in winter, this probably would not be true. There seems to be an erroneous idea prevalent among construction men that concrete should harden as rapidly as possible. They believe that concrete drys out in hardening similar to the action of lime mortar and therefore they provide no protection while the concrete is hardening. This state of affairs is no doubt due to the passing of many masons and helpers from their original field into the concrete field. Some of these so-called *practical* men *will* not be converted from this erroneous view and a vigorous campaign should be started against such ideas.

The very name "hydraulic" as applied to cements conveys the idea that water is required in the process of hardening. Exposed surfaces of fresh concrete should be protected from the direct hot rays of the sun by boards, building paper, or tarpaulins until final set has taken place; after this it is important that the concrete be kept moist for a period of a week or more after placing. If not kept moist and protected, there is danger of the water which is required for the process of setting and hardening becoming evaporated and the concrete "dried out" before the cement has set. Concrete that has prematurely set or dried out is never as strong as if kept moist while setting, and many times ultimate failure is laid to poor cement or aggregate when in reality the cause was lack of water while hardening.

The statement that the strength of concrete increases with age does not hold good if sufficient water is not supplied throughout the first stages of the hardening process. If the moisture is withdrawn from the concrete the increase in strength is arrested; and even if water is applied later it will do no good toward increasing the strength.

When concrete is unprotected and hardens rapidly, the tendency toward contraction is greatly aggravated and the outer surface is very likely to become "crazed" or covered with "hair cracks" and rendered otherwise unsightly. If concrete drys rapidly the color will be much lighter than if kept damp and allowed to harden slowly.

After an exposed concrete surface has received its final set, it should be covered with burlap (not cement sacks, they are too valuable) or wet sand spread over the surface to a depth of about one inch, and kept wet by sprinkling. Where surfaces are not exposed but the concrete section is thin, the forms are likely to be very light, and if exposed to the sun will dry out quickly and absorb moisture from the concrete next to the forms. For this reason it is important to see that such forms are thoroughly soaked daily for a period of a week or more.

Impress upon the contractor, inspector and workman, that *water* is an *essential element* in the proper curing of concrete and *better concrete will result.*

A Suggested Inspection Tour.

AT THE present time there are under construction three of the largest bridges of their respective types in America, viz.: The Tunkhannock concrete arch bridge of the D. L. & W. R. R.; the Hell Gate steel arch of the New York Connecting R. R., and the Quebec steel cantilever bridge over the St. Lawrence river.

It seldom occurs that structures of such great size and of such widely different types are being built at the same time within such relatively short distances from one another; thereby affording the engineer a chance to view the construction of all in a short time. It behooves every engineer who chances to have business at points near these structures to spare the time to visit one or all of the structures. As a vacation trip for the progressive engineer it should prove most delightful and instructive.

The Tunkhannock viaduct is located on the Summit cut-off of the Delaware, Lackawanna & Western R. R., at Nicholson, Pa., about 45 minutes' ride north of Scranton, Pa., on the D. L. & W. R. R. This structure, composed of two 100-ft. and ten 180-ft. ribbed arch spans with a total length of 2,230 ft., and a height of 240 ft. above the creek level, will when completed, be the largest concrete arch bridge for railway service ever built. A short description of this structure was given on page 514 of the November, 1912, issue of *Railway Engineering.* Piers for this bridge are now being constructed and the steel arch centers for arches will be in place in a few months.

The Hell Gate steel arch of 977-ft. 6 in. span with massive concrete towers is briefly described elsewhere in this issue. This structure forms a part of a bridge over three miles long over the East River between the Borough of the Bronx, New York, and Long Island City, for the New York Connecting R. R. The other features of this work are also very interesting, but the Hell Gate arch takes precedence on account of its long span. Portions of this bridge containing a great amount of

concrete work are fairly well advanced, the foundations of piers for the arch span, however, are just in the process of construction, making an inspection at this time very interesting.

The Quebec bridge, a double-track railroad structure being built by the Canadian Government is located a few miles above Quebec, over the St. Lawrence River. The structure will be 3,239 ft. long between abutments composed of two 515-ft. anchor arm spans 310 ft. deep and 1,800-ft. channel span. At the present time the construction of the substructure is well advanced.

Should any of our readers be fortunate enough to have occasion to visit any one or all of the above mentioned monumental engineering works, they can confer a valuable service to their less fortunate fellow readers by sending for publication descriptions and impressions gained from viewing the actual construction operations of these gigantic works of modern engineering.

CURRENT PRICES CONCRETE MATERIALS.

Portland Cement—Boston, $1.72; Pittsburgh, $1.65; Buffalo, $1.64; Cleveland, $1.76; Detroit, $1.74; Milwaukee, $1.74; Chicago, $1.65; Duluth, $1.93; Minneapolis and St. Paul, $1.80.

Above prices are f. o. b. cars at points mentioned, with 40 cents credit when bags are returned. We are indebted to the Universal Portland Cement Co. for the above prices.

Crushed Stone—New York—1½ in. stone, 85c to 95c per cu. yd.; ¾ in. stone, 90c to $1 for full cargo lots at docks.

Chicago—1½ in. stone, $1.15 per cu. yd. f. o. b. Chicago.

Gravel—Chicago—$1.15 per cu. yd. f. o. b. Chicago.

New York—85c to 90c per cu. yd. for full cargo lots at docks.

Sand—Chicago—$1.15 per cu. yd. f. o. b. Chicago.

New York—50c per cu. yd. at docks.

Reinforcing Bars—Pittsburgh base quotations on mill shipments f. o. b. Pittsburgh are 1.40c on plain bars and 1.45c on deformed bars, with the prevailing extras for bars under ¾-inch or base. Shipments from Pittsburgh stock are being made at 1.95c base; Chicago stock 2.00c base in large lots. New York stock 2.25c base. Tendency of market is toward lower prices.

The Esquimault & Nanaimo is preparing plans for new freight and passenger yards at Nanaimo, B. C., and a new passenger station also will be built shortly.

The Great Northern has awarded a contract to Grant Smith & Co., Seattle, Wash., for building 2 steel bridges and 1½ miles of snow sheds for $700,000.

The Great Northern has placed contracts for 165 tons of plate girder spans.

The new general office building and depot of the Houston & Brazos Valley located in Freeport, Tex., has been completed.

The Intercolonial Ry. of Canada has awarded contract for the first section of its terminal work at Halifax, N. S., in connection with the extensive harbor scheme which the government has decided upon for that port. The present contract is for five miles of cut-off from Rockingham, near Halifax, to the location of the proposed new docks, and will involve an enormous amount of work, as the engineering difficulties are large. The contract price is $1,500,000, and is in two sections. The successful bidders are the Cook Construction Co., of Sudbury, Ont., and A. B. Wheaton, of Amherst, N. S.

The Intercolonial will build extensions, it is said, to the present freight car shops at Moncton, N. B.

The new concrete and steel freight depot which the International & Great Northern has been erecting at Taylor, Tex., at a cost of $30,000, is completed and ready for occupancy, noted March 29.

The Lake Shore & Michigan Southern has placed contracts for 315 tons of structural steel involved in the erection of car sheds at Englewood, Chicago, Ill.

ABSTRACTS FROM REPORT OF SPECIAL COMMITTEE ON CONCRETE AND REINFORCED CONCRETE, A. S. C. E. 1913. DETAILS OF CONSTRUCTION.

I. Joints.

(a) *Concrete.*—For concrete construction it is desirable to cast the entire structure at one operation, but as this is not always possible, especially in large structures, it is necessary to stop the work at some convenient point. This point should be selected so that the resulting joint may have the least possible effect on the strength of the structure. It is therefore recommended that the joints in columns be made flush with the lower side of the girders, that the joints in girders be at a point midway between supports, but should a beam intersect a girder at this point, the joint should be offset a distance equal to twice the width of the beam; that the joints in the members of a floor system should in general be made at or near the center of the span.

Joints, in columns, should be perpendicular to the axis of the column, and in girders, beams, and floor slabs perpendicular to the plane of their surfaces.

Girders should never be constructed over freshly formed columns without permitting a period of at least 2 hours to elapse, thus providing for settlement or shrinkage in the columns.

Shrinkage and contraction joints may be necessary in concrete subject to great fluctuations in temperature. The frequency of these joints will depend, first, on the range of temperature to which the concrete will be subjected, and second, on the quantity and position of the reinforcement. These joints should be determined, and provided for in the design. In massive work, such as retaining walls, abutments, etc., built without reinforcement, contraction joints should be provided at intervals of from 25 to 50 ft. and with reinforcement from 50 to 80 ft. (the smaller the height and thickness, the closer the spacing throughout the length of the structure). To provide against the structure being thrown out of line by unequal settlement, each section of the wall should be tongued and grooved into the adjoining section. A groove should be formed in the surface of the concrete at vertical joints in walls or abutments. Shrinkage and contraction joints should be lubricated by either an application of petroleum residuum oil or a similar material, so as to permit a free movement at the joint when the concrete expands or contracts.

The insertion of a sheet of copper or zinc, or even tarred paper, will be found advantageous in securing expansion and contraction at the joint.

(b) *Reinforcement.*—Wherever it is necessary to splice, tension reinforcement, the length of lap should be determined on the basis of the safe bond stress, the stress in the bar, and the shearing resistance of the concrete at the point of splice; or a connection should be made between the bars of sufficient strength to carry the stress. Splices at points of maximum stress should be avoided. In columns, bars more than ¾-in. in diameter, not subject to tension, should be properly squared and butted in a suitable sleeve; smaller bars may be treated by imbedment in large masses of concrete. At foundations, bearing plates should be provided for supporting the bars, or the bars may be carried into the footing a sufficient distance to transmit the stress of the steel to the concrete by means of the bearing and bond resistance; in no case shall the ends of the bars be permitted merely to rest on concrete.

Fire-Proofing.

The actual fire tests of concrete and reinforced concrete have been limited, but experience, together with the results of tests thus far made, indicate that concrete, on account of its low rate of heat conductivity and the fact that it is incombustible, may be used safely for fire-proofing purposes.

The dehydration of concrete probably begins at about 500° Fahr., and is completed at about 900° Fahr., but experience

indicates that the volatilzation of the water absorbs heat from the surrounding mass, which together with the resistance of the air cells, tends to increase the heat resistance of the concrete, so that the process of dehydration is very much retarded. The concrete that is actually affected by fire remains in position and affords protection to the concrete beneath it.

The thickness of the protective coating required depends on the probable duration of a fire which is likely to occur in the structure, and should be based on the rate of heat conductivity. The question of the conductivity of concrete is one which requires further study and investigation before a definite rate for different classes of concrete can be fully established. However, for ordinary conditions, it is recommended that the metal in girders and columns be protected by a minimum of 2 in. of concrete, that the metal in beams be protected by a minimum of 1½ in. of concrete; and that the metal in floor slabs be protected by a minimum of 1 in. of concrete.

It is recommended that, in monolithic concrete columns, the concrete to a depth of 1½ in. be considered as protective covering, and not included in the effective section.

It is recommended that the corners of columns, girders, and beams be beveled or rounded, as a sharp corner is more seriously affected by fire than a round one.

Water-Proofing.

Many expedients have been used to render concrete impervious to water under normal conditions, and also under pressure conditions that exist in reservoirs, dams, and conduits of various kinds. Experience shows, however, that where mortar or concrete is proportioned to obtain the greatest practicable density and is mixed to a rather wet consistency, the resulting mortar or concrete is impervious under moderate pressure.

A concrete of dry consistency is more or less pervious to water, and compounds of various kinds have been mixed with the concrete, or applied as a wash to the surface, for the purpose of making it water-tight. Many of these compounds are of but temporary value, and in time lose their power of imparting impermeability to the concrete.

In the case of subways, long retaining walls, and reservoirs, provided the concrete itself is impervious, cracks may be so reduced by horizontal and vertical reinforcement properly proportioned and located, that they are too minute to permit leakage, or are soon closed by infiltration of silt.

Coal-tar preparations, applied either as a mastic or as a coating on felt or cloth fabric, are used for water-proofing, and should be proof against injury by liquids or gases.

For retaining and similar walls in direct contact with the earth, the application of one or two coatings of hot coal-tar pitch to the thoroughly dried surface of concrete is an efficient method of preventing the penetration of moisture from the earth.

Surface Finish.

Concrete is a material of an individual type, and should not be used in imitation of other structural materials. One of the important problems connected with the use is the character of the finish of exposed surfaces. The finish of the surface should be determined before the concrete is placed and the work should be conducted so as to make possible the finish desired. For many forms of construction, the natural surface of the concrete is unobjectionable, but frequently the marks of the boards and the flat dead surface are displeasing, making some special treatment desirable. A treatment of the surface, either by scrubbing it while green or by tooling it after it is hard, which removes the film of mortar and brings the aggregate of the concrete into relief, is frequently used to remove the form markings, break the monotonous appearance of the surface, and make it more pleasing. The plastering of surfaces, as ordinarily applied, should be avoided, for, even if carefully done, it is likely to peel off under the action of frost or temperature changes.

Concrete Practice No. 9, Missouri Pacific Ry.

A. M. Wolf, C. E.

The Missouri Pacific Railway Company employs concrete, both plain and reinforced, in the construction of a great variety of designs, as shown by the plans reproduced here. The use of reinforced concrete is especially extensive and the detail designs described should be of interest to the progressive engineer engaged in design and construction.

Plain Concrete Flaring Wing Abutment.

The plain concrete pier shown is composed of 1:3:6 concrete, except the bridge seat, which is 1:2½:5 concrete. Forces assumed as acting in design were earth pressure in accordance with Rankine's formula, a live load of 500 pounds per square foot behind the abutment and a vertical live load equal to the end shear of the span for Cooper's E-50 loading without impact. The allowable bearing on the bridge seat under the bridge pedestal is 500 pounds per square inch.

The footing 4 feet 5½ inches thick and 3 inches wide at center line of the abutment, which has a total height of 24 feet, rests on four rows of 20-foot piles spaced as shown. The abutment is 9 feet wide at the top of footing, which is equivalent to about one-half the height above the footing. Face batter of the abutment is 1 inch to 1 foot, while the back batter is 3½ inches to 1 foot, thus making the top thickness 5 feet 4 inches, not including the 3-inch projection of the coping. The bridge seat is 2 feet 9 inches wide over all and is 6 feet ½ inch below the base of rail. The coping of bridge seat, which projects 3 inches, is 18 inches deep. The back wall has a vertical face and battered back with a top thickness of 1 foot 6 inches and a thickness at the bridge seat of 2 feet 10 inches. The front edge of the bridge seat has a 3-inch by 1½-inch chamfer. Wing walls have a flare of 30 degrees with the face of the abutment, a top thickness of 1 foot 11 inches and a top slope of 20¼ inches to 1 foot.

Reinforced Concrete Flaring Wing Abutment.

The reinforced concrete counterfort abutment for a single-track girder span, shown here, has a total height of 40 feet 7 inches from bottom of footing to base of rail, with a face wall 1 foot 3 inches thick at all points, and not of increasing thickness at the bottom, as is the usual practice in such designs.

This abutment was designed for earth pressure in accordance with Rankine's formula; a live load of 500 pounds per square foot behind the abutment and a live load applied at the top of the abutment equivalent to the end shear of span for Cooper's E-50 loading without impact. The allowable bearing on concrete under bridge pedestals was 500 pounds per square inch. The concrete used was a 1:2:4 mixture, with crushed rock or gravel not more than 1½ inches in any diameter as the coarse aggregate. The allowable unit stresses used in design were 650 pounds per square inch compression in concrete and 16,000 pounds tension in steel, which is in general high carbon deformed stock. All deformed bars are lapped 30 diameters at splices and securely tied with wire.

The footing course of reinforced concrete is 2 feet 6 inches thick and 18 feet wide at the center line of abutment, which is equivalent to nearly 50 per cent of the height from base of footing to top of bridge seat, this height being 36 feet 6 inches. The width at ends of wings is 9 feet. The footing projects 3 feet beyond the face wall of main portion of abutment, the projection of footing for wings gradually diminishing to 2 feet at

the ends of same. The footing rests on solid rock and is connected to the rock by anchors 3 feet centers. The transverse reinforcement consists of 1-inch diameter bars 7 feet 6 inches long spaced 6 inches centers in bottom of footing in the front portion; at the ends of wings smaller bars and wider spacings are used. At buttresses two of the transverse bars extend the width of the footing. The longitudinal reinforcement of main portion of abutment is made up of fourteen 1-inch diameter bars 23 feet long spaced 8 inches in bottom rear half and six 1-inch diameter bars 23 feet long 9 inches in center, in top of slab just back of the face wall connection. Longitudinal bars in wings are placed only in bottom of footing near the back and are of sizes and length shown on plans.

The face wall of abutment and wings is 1 foot 3 inches thick with a batter of 1 inch to 1 foot, the height of same from top of footing to bottom of bridge seat being 32 feet. The face wall is reinforced with ¾-inch diameter bars horizontally with spacing varying from 6 to 14 inches, as shown in the details, and ½-inch diameter vertical bars about 18 inches centers, near outer face of main breast wall and staggered 18-inch centers front and back in the wings between buttresses. Two ¾-inch bars are placed vertical near face at each buttress. Vertical bars extend only to top of footing, the wall being doweled to the latter by short dowels of the same size as the vertical bars with which they lap. The main abutment face is 19 feet wide under bridge seat and 20 feet 6 inches wide at the footing.

The top wings are sloped off at 1½ to 1 and are reinforced with two ¾-inch bars parallel to the top. The wings have a flare of 30 degrees with the face of the abutment.

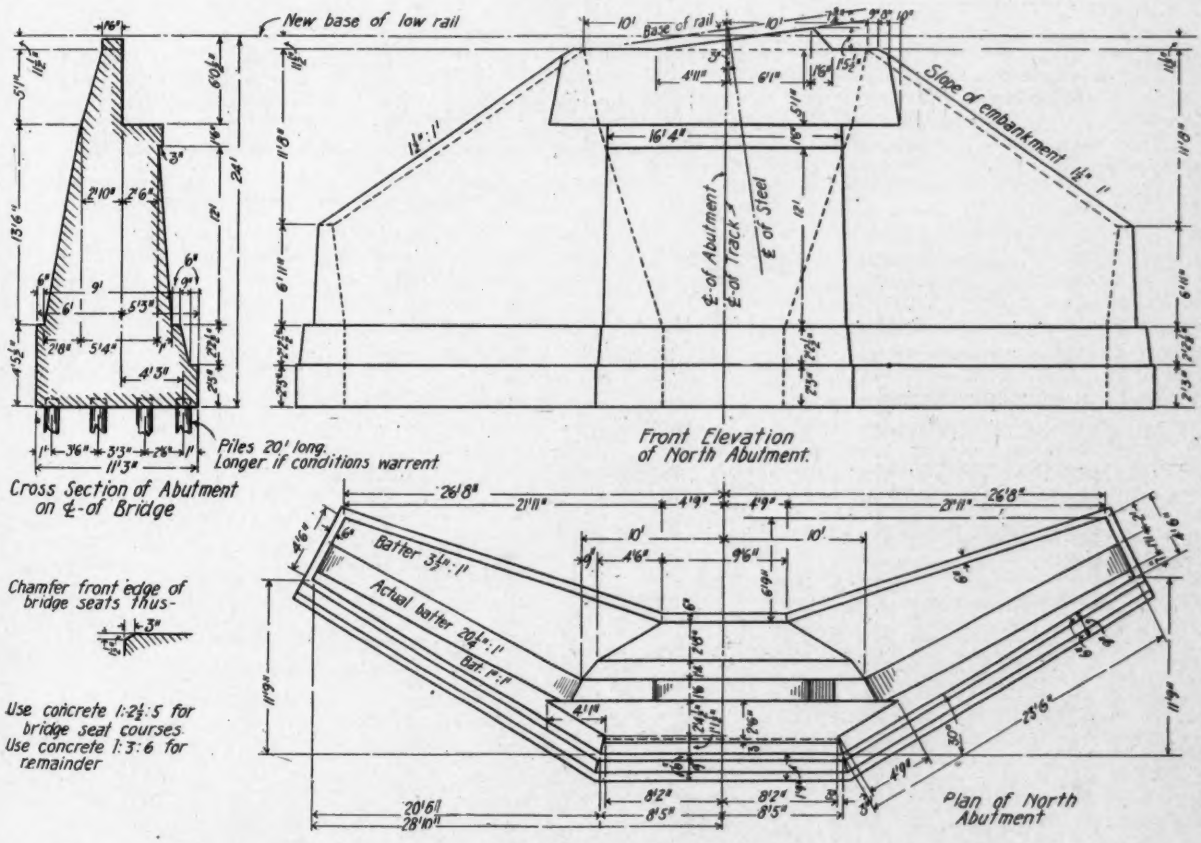
The three buttresses or counterforts under the bridge seat are 18 inches thick and are spaced 9 feet 2 inches centers, while the wing wall buttresses are 1 foot thick and spaced 11 feet centers. All buttresses are connected to the face wall with 1x1-foot fillets. They extend within 2½ inches of the back of footing and are battered from this point to the top of the wall.

The horizontal reinforcing bars are bent with a 6-inch hook at one end to tie them to vertical bars near face of wall. These bars are ½-inch rounds and the spacing varies from 9-inch centers to 24-inch centers at the top in the main buttresses and in a similar manner in the others. The vertical bars (½-inch diameter) are hooked around the bars in bottom of the footing in the same manner as the horizontal bars engage the verticals in the face wall. The tension reinforcement in the backs of main counterforts consists of ten 1¼-inch diameter bars hooked around the longitudinal bars in footing. All of these bars do not extend the full height, but some are stopped off at various points where not longer required to care for tensile stresses, as shown on the detail plans. The other buttresses are reinforced in a similar manner. The fillets between counterforts and face wall have ½-inch diameter rods horizontal, parallel to face of fillet, spaced 2 feet centers.

The bridge seat is 2 feet thick, 3 feet 8 inches wide to face of back wall and is heavily reinforced with 1-inch diameter straight and bent-up bars and six prong stirrups of ⅝-inch bars. The bridge seat is designed as a continuous slab over the buttresses and bars are bent up into top of slab at these points to provide for the negative movement.

The back wall has a vertical face and a battered back and is reinforced with two ¾-inch bars horizontal in top and with ¾-inch vertical about 9-inch centers in back of wall and 3-foot centers in face at the buttresses bars bent so as to hook over the horizontal bars extend into the former for some distance.

All exposed edges of 90 degrees or less have a 1-inch bevel.

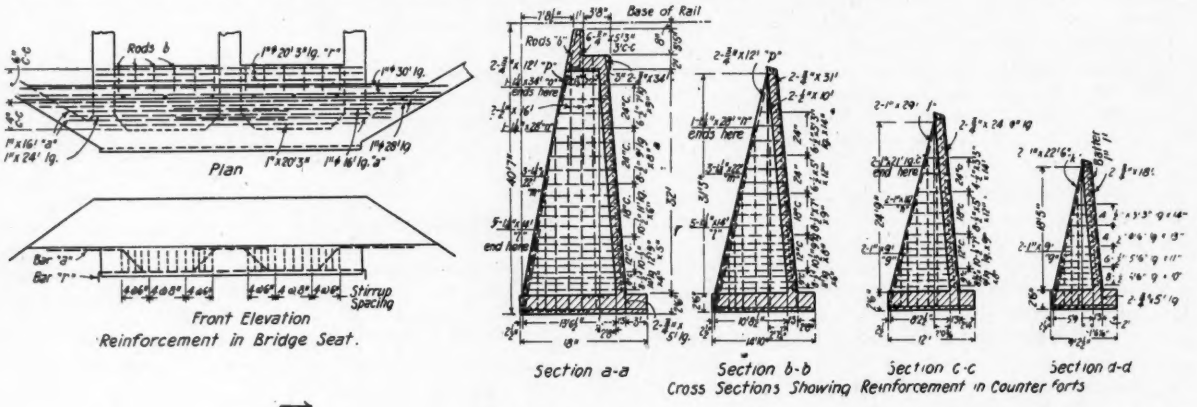

New base of low rail
Base of rail
Slope of embankment 1½ : 1
℄ of Abutment
℄ of Track
℄ of Steel
Front Elevation of North Abutment.
Piles 20' long. Longer if conditions warrent
Cross Section of Abutment on ℄ of Bridge
Batter 3½" : 1'
Actual batter 20¼" : 1'
Bat. 1" : 1'
Chamfer front edge of bridge seats thus-
Use concrete 1:2½:5 for bridge seat courses
Use concrete 1:3:6 for remainder
Plan of North Abutment

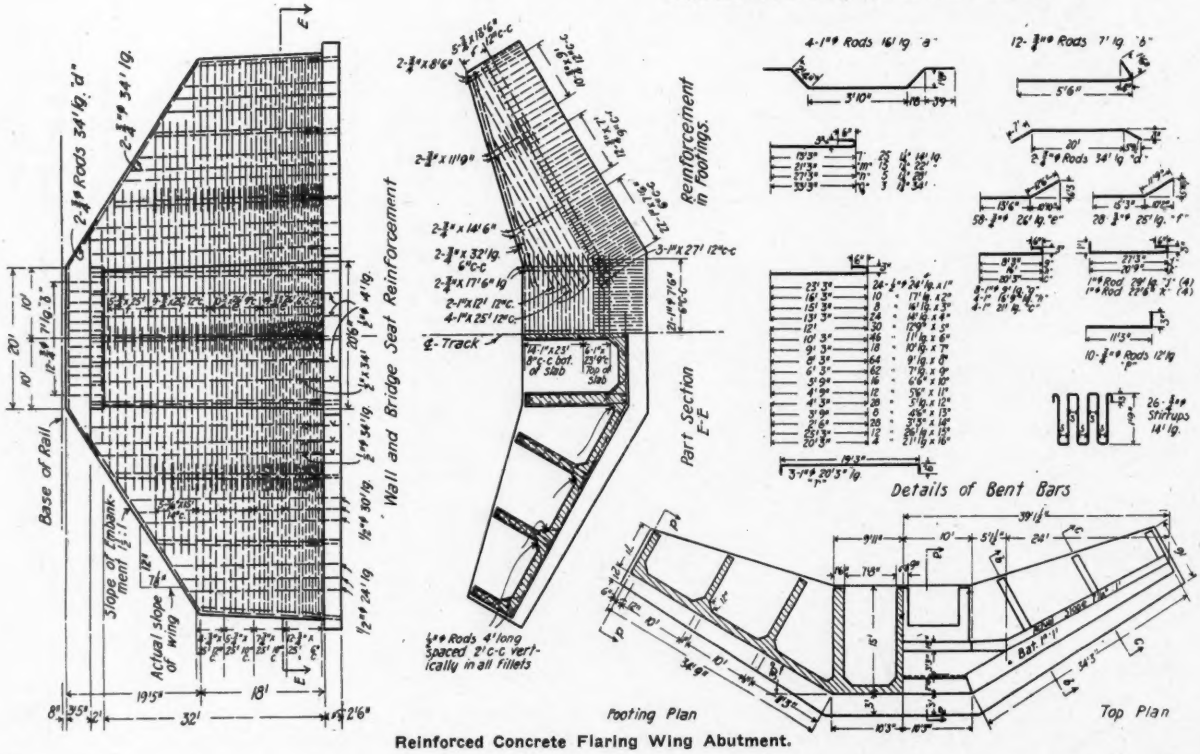
Plain Concrete Flaring Wing Abutment.

Reinforced Concrete Submerged Abutment, Straight Wing Abutment and Plain Concrete Pier for Single-Track Bridge.

The structures described here were used for one bridge and show very forcibly the ease with which concrete can be adapted to best suit the conditions at hand.

The roadway under west end of bridge was at such an elevation as to preclude the omission of the pier on account of lack of head room if a long span girder was used, and a straight wing abutment was required to retain the earth fill. At the east end the long sloping bank of the river made the conditions ideal for a submerged or buried abutment of such type as to retain only the top portion of the fill while the remainder sloped unhindered through the abutment. Such an abutment is decidedly cheaper than a wing abutment where the fill is a high one.





Reinforced Concrete Flaring Wing Abutment.

Submerged Abutment.

The submerged or buried abutment consists of a reinforced concrete footing course resting on piles, carrying two longitudinal reinforced concrete walls which support the bridge seat and the wing and back walls above the bridge seat. All concrete used in this structure was of a 1:2:4 mixture. The forces assumed as acting on the abutment and the unit stresses used in design were the same as given for the flaring wing abutment just described. Reinforcing bars used were deformed rounds of high carbon steel.

The footing 15 feet long, 10 feet wide and 2 feet 9 inches thick, is heavily reinforced in both directions, top and bottom, and rests on 15 piles 30 feet long projecting 6 inches into the footing. The transverse bars are straight, while the longitudinal are both straight and bent. The bent bars are bent up into the top of the slab between the supporting walls to provide for negative moment in that portion.

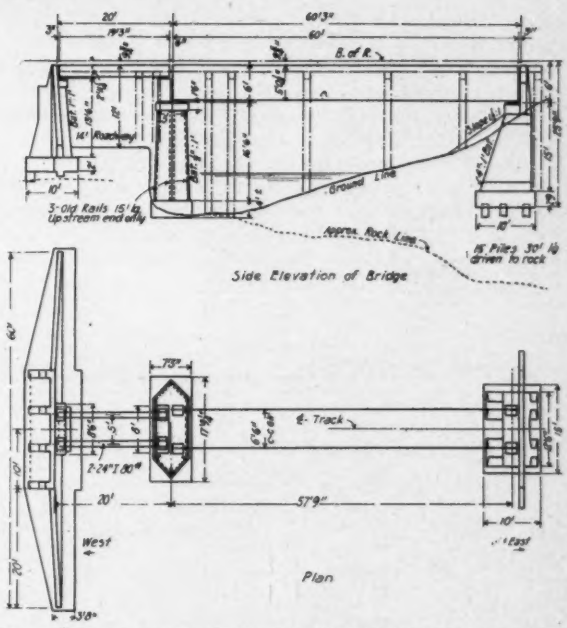
The columns, or rather the walls supporting the bridge seat, are connected to the footing with 1 foot 6 inch fillets reinforced with eight ¾-inch fillet bars 5 feet long spaced 1 foot centers, and doweled to footing front and back by ¾-inch bars 4 feet long. The walls are 1 foot 6 inches thick, having a vertical back, a face batter of 4 inches to 1 foot and are reinforced horizontally and vertically as shown.

The four ¾-inch diameter vertical bars in the back are continued to the top of the back wall, thus providing extra stiffness to same at the point of connection with the wing. The height of walls from top of footing to bottom of bridge seat is 13 feet, the top width being 4 feet 4 inches and the bottom width 8 feet

8 inches, the footing projecting 8 inches beyond wall faces at front and back. The vertical walls are filleted to the bridge seat in same manner as at the footing. The distance center to center of walls is 8 feet.

The bridge seat is 2 feet thick, 12 feet 6 inches long and 2 feet 9 inches wide. The main reinforcement between buttresses consists of 12 1-inch diameter bars 13 feet long spaced 4½ inches centers. Six of these bars bend up into top of slab 2 feet from support at each end, the other end of bar continuing to the end of slab at the bottom. Transverse bars bent up into the back wall act as distributing bars in the bridge seat and cantilever reinforcement in the back wall. The back wall is 1 foot thick at top and 2 feet thick at the bridge seat, the back being battered. The wing walls 1 foot thick and 7 feet 2¼ inches high, project 7 feet beyond the ends of bridge seat. The corners of wings are cut off at a slope of 1½ to 1. They are reinforced horizontally at the back face with bars extending from end to end through the back wall and by ⅜-inch diameter vertical distributing bars.

All reinforcing bars were placed so as to be at least 1½ inches from surface concrete. All exposed edges of 90 degrees or less have a 1-inch bevel. The back fill of this abutment extends completely under the bridge seat and was well tamped and packed when placed.

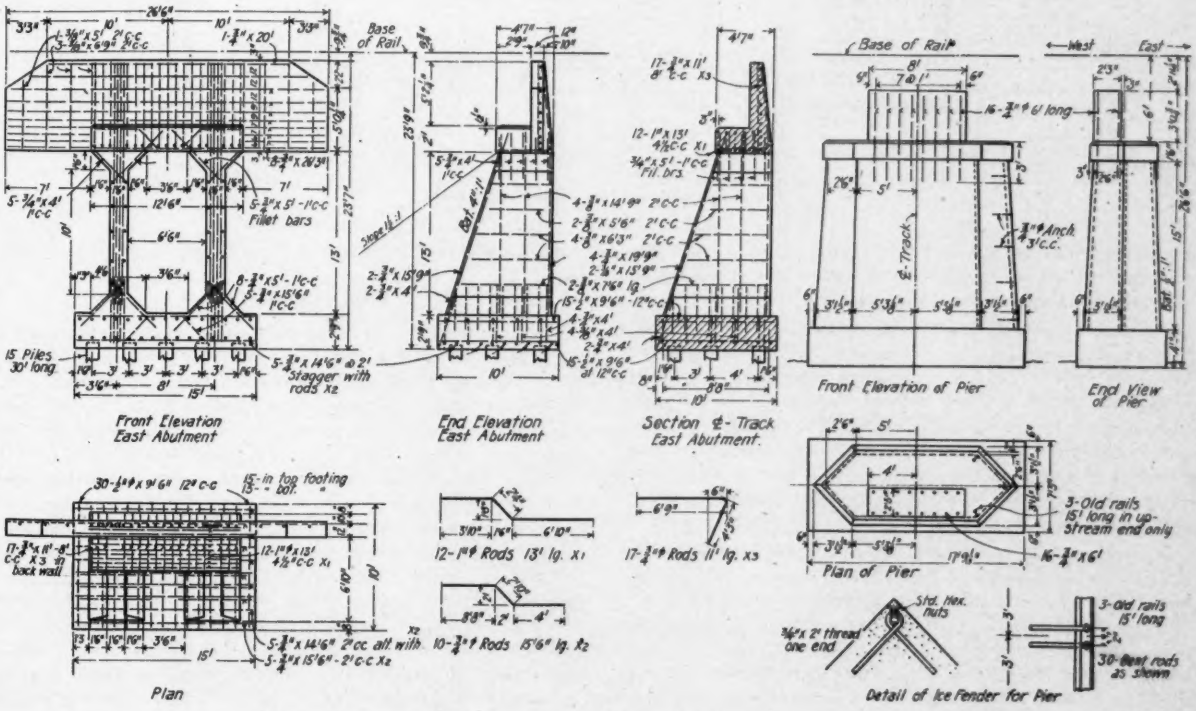


Bridge with Submerged and Straight Abutments of Reinforced Concrete, and with Plain Concrete Piers.

Reinforced Concrete Straight Wing Abutment.

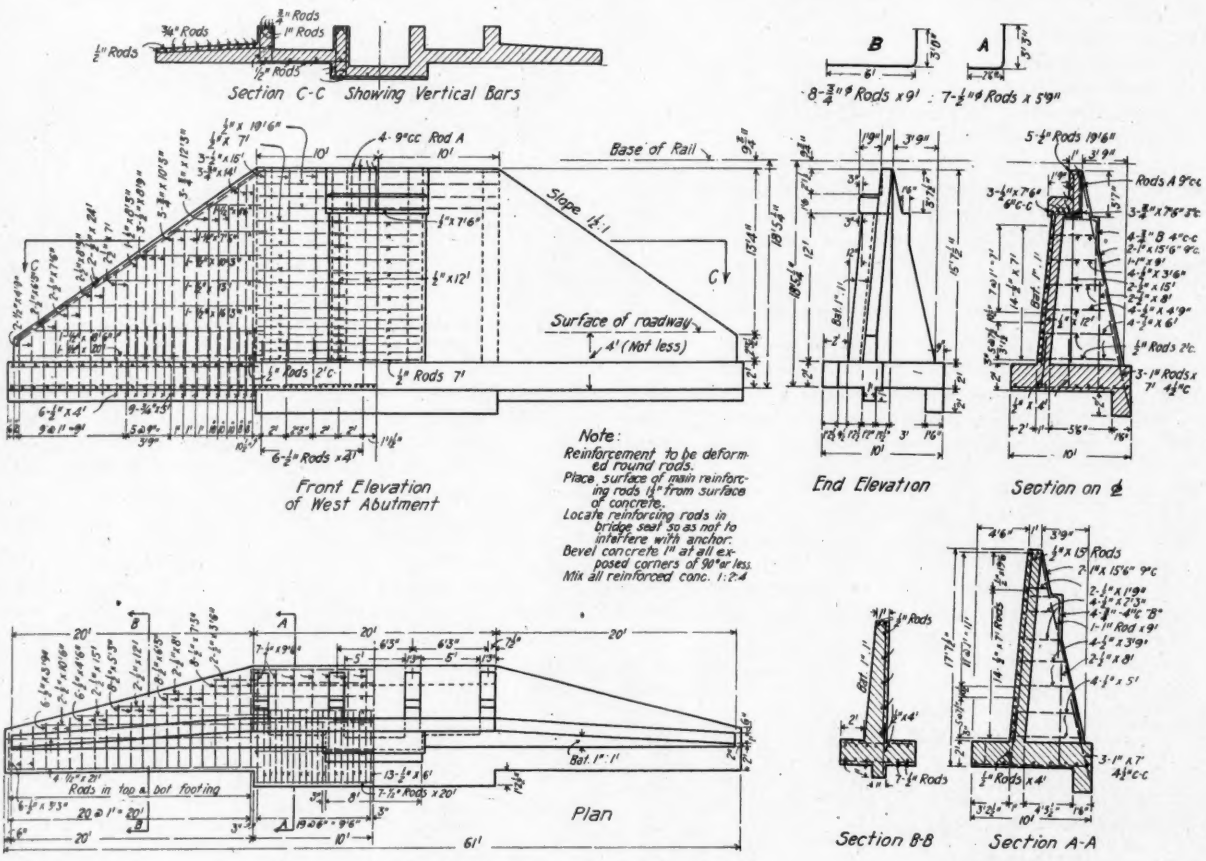
The straight wing abutment illustrated is designed for the same loads and unit stresses as the flaring wing abutment previously described, all concrete used being of a 1:2:4 mixture.

The total height of the abutment above the bottom of footing is 17 feet 7½ inches and the base width 10 feet, which is equivalent to nearly 0.6 of the height. The footing course for the main portion of the abutment is 2 feet thick with a projection 18 inches wide at the heel extending 2 feet farther to provide extra stability against sliding and sufficient anchorage for the tension bars in the back of the counterforts. The footing projects 3 feet 2½ inches beyond the face wall and 9 inches beyond the back of counterforts. The main reinforcement consists of ½-inch diameter bars parallel to center line of abutment, every third bar extending the full width of footing, while the others extend only 6 feet from the toe; these bars are spaced 6 inches centers. Transverse distributing bars are placed over the main reinforcement. At a point 10 feet from center line of abutment the front of footing drops back 1 foot 2½ inches, making the projection only 2 feet for the wing footings. The back is tapered off toward the front, making the width at the end 3 feet 8 inches. The wings are designed as cantilever walls with a 1x1-foot projection below the footing to give additional anchorage for bars and stability against sliding. The back of this projection is on a line with back of wing, which is



Submerged Abutment. **Plain Concrete Pier.**

vertical. The footing 2 feet thick is reinforced with ½-inch diameter bars 1-foot centers in top and bottom perpendicular to wing and ½-inch diameter bars top and bottom about 1-foot centers at right angles to these. The wings have a top width of 1 foot, a face batter of 1 inch to 1 foot and a top slope of 1½ to 1. At points near main portion of abutment dowel bars are placed in footings and the vertical bars in back of wall lap with these, near the end of wings the dowels are omitted, the main bars being placed in the footings directly. The vertical bars consist of ¾-inch diameter spaced 1-foot centers in high portion, ½-inch diameter 9-inch centers in intermediate portion and ½-inch diameter 1-foot centers in ends; ½-inch horizontal are placed horizontally under bridge seat and bent down vertically into buttress at the back. These bars act to distribute the load over the buttress or counterfort. The counterforts slope from footing up to top of back wall, which is 1 foot thick with vertical faces. The bridge seat, 1 foot 6 inches thick, is reinforced with three ½-inch diameter bars in bottom over the face wall, and one ½-inch and three ¾-inch near the rear under the back wall. The back of back wall has ½-inch vertical bars 9-inch centers bent horizontal into bottom of bridge seat. Two ½-inch bars are placed in top of back wall and the same number horizontal in the outer face. The counterforts at the wing wall connections are similarly reinforced. This abutment is an excel-


Section C-C Showing Vertical Bars
8-¾" ⌀ Rods x 9'
7-½" ⌀ Rods x 5'9"
Base of Rail
Slope 1½:1
Surface of roadway
4' (Not less)
Front Elevation of West Abutment
Note:
Reinforcement to be deformed round rods.
Place surface of main reinforcing rods 1½" from surface of concrete.
Locate reinforcing rods in bridge seat so as not to interfere with anchor.
Bevel concrete 1" at all exposed corners of 90° or less.
Mix all reinforced conc. 1:2:4
End Elevation
Section on ℄
Plan
Section B-B
Section A-A

Straight Abutment, Reinforced Concrete.

distributing bars are spaced 2-foot centers. Two ½-inch diameter bars are placed in top of wall to prevent shrinkage and unequal settlement cracks to some extent.

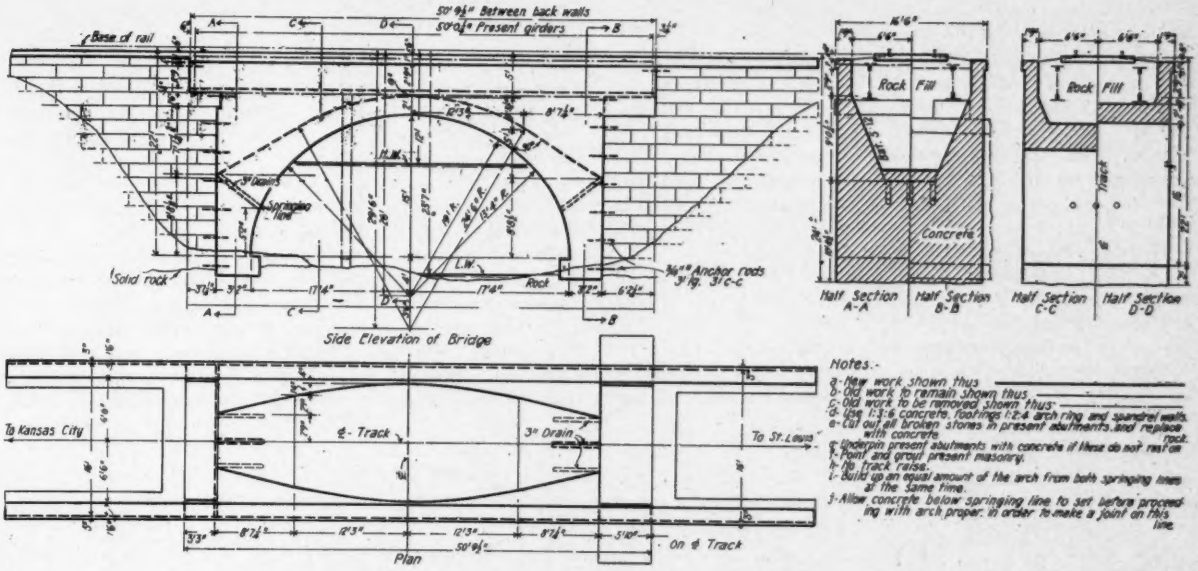
The main abutment is a counterfort wall 1 foot thick with a batter of 1 inch in 12, reinforced as a vertical slab supported by counterforts 6 feet 3 inches centers. The part carrying the bridge seat, which is 8 feet 6 inches long and 1 foot 9 inches wide, projects 1 foot beyond the sides of the breast wall. This wall is reinforced with ½-inch diameter horizontal bars spaced about 7½-inch centers for a distance of 3 feet at bottom, and 1-foot centers above. Vertical distributing bars (½-inch) are provided about 2 feet on centers.

The two central counterforts supporting the bridge seat are 1 foot 3 inches thick and 6 feet 3 inches wide at the base reinforced with horizontal ½-inch bars arranged in pairs 2 feet on centers. Two pairs of vertical bars are also provided. The tension reinforcement in back of counterforts consists of three 1-inch diameter bars 7 feet long as dowels to footing and three 1-inch bars above the footing, one 9 feet long and two 15 feet 6 inches long, extending to top of back wall. Four ¾-inch bars

lent example of a combination of counterfort and cantilever walls.

Plain Concrete Pier.

The plain concrete pier about 16 feet 6 inches high above footing to main bridge seat has a base width of 6 feet 3 inches, or about 0.4 of the height. The footing is 7 feet 3 inches wide and 17 feet 9¼ inches long, projecting 6 inches beyond the end of pier, which has a beveled cutwater. The footing, about 4 feet thick, rests on solid rock. The pier faces have a batter of ½ inch to 1 foot and a 45-degree cutwater at both ends. The top width under coping is 5 feet, which is standard, except in special cases where it is varied to suit conditions. The upstream end is reinforced with three old rails 15 feet long, anchored to the pier by ¾-inch diameter bent bars 2 feet long placed in pairs 3-foot centers. The bridge seat, 18 inches thick, projects 3 inches beyond the neatwork of pier and has the upper edge chamfered. To provide a seat for the short span at the west end a block of concrete 8 feet long, 3 feet high and 2 feet 3 inches wide is placed on the top of pier and anchored to same by sixteen ¾-inch diameter dowels 6 feet long, eight in each


Base of rail
50'0½" Between back walls
50'0⅛" Present girders
Rock Fill
Concrete
Half Section A-A
Half Section B-B
Half Section C-C
Half Section D-D
Solid rock
Rock
¾" ø Anchor rods 3' lg. 3'-0 c-c
Side Elevation of Bridge
To Kansas City
℄ Track
3" Drain
To St. Louis
Plan
Notes.-
a- New work shown thus
b- Old work to remain shown thus
c- Old work to be removed shown thus
d- Use 1:3:6 concrete. Footings 1:2:4 arch ring and spandrel walls.
e- Cut out all broken stones in present abutments and replace with concrete
f- Underpin present abutments with concrete if these do not rest on rock.
h- Point and grout present masonry.
h- Re Track raise.
i- Build up an equal amount of the arch from both springing lines at the same time.
j- Allow concrete below springing line to set before proceeding with arch proper in order to make a joint on this line.

Plain Concrete Arch.

face. The allowable bearing on bridge seat is 500 pounds per square inch.

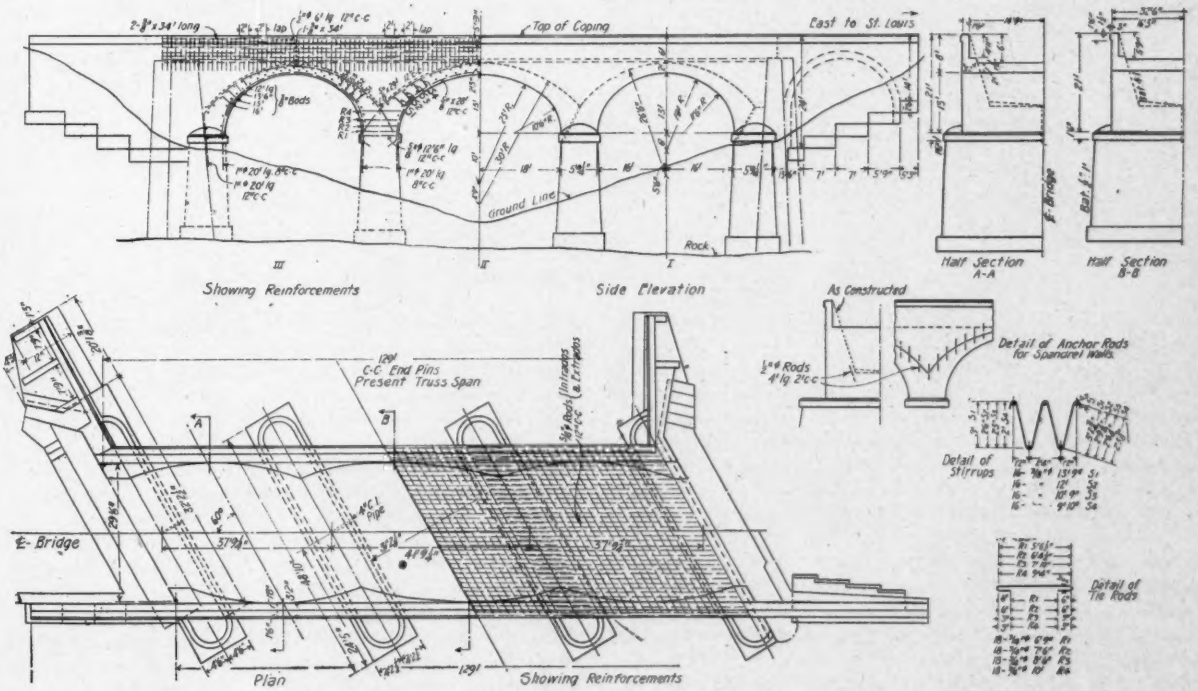
The pier was designed for Cooper's E-50 loading without impact and the dead load of span. The concrete used was a 1:3:6 mixture, except in bridge seat, which was a 1:2½:5 mixture.

Plain Concrete Arch Bridge.

The plain concrete arch illustrated herewith was built to replace a 50-foot deck girder span, without stopping traffic, the top of arch ring being just a few inches below bottoms of girders. The old masonry U-abutments were used for the arch by adding a concrete facing.

The arch is three-centered, with a clear span of 34 feet 8 inches and an actual rise of 9 feet 10 inches, the apparent rise from top of footings being 15 feet. The arch ring composed of 1:2:4 concrete, is 2 feet thick at the crown and has a radial thickness of about 6 feet at the spring. It was designed for Cooper's E-50 loading with impact amounting to about 25 per cent. The concrete was assumed to weigh 150 pounds, earth fill, 100 pounds per cubic foot. The arch ring was analyzed under various conditions of loading by the elastic theory, it being the practice of this road to use the elastic theory in analyzing all arches of over 30-foot span.

The old abutments were faced with a 1:3:6 concrete 3 feet 2 inches thick tied to the masonry by ¾-inch square dowels 3 feet long spaced 3-foot centers both ways. This concrete facing has a footing course with a projection of 1 foot resting on solid rock. All broken and disintegrated stones in the existing abutments were cut out and replaced with concrete and were underpinned where necessary to carry them to rock. The concrete



Reinforced Concrete Arch Bridge.

below the springing line was allowed to set before proceeding with the arch proper in order to make a joint at that line.

The spandrel walls are of 1:2:4 concrete and are gravity walls. At the crown of arch the back of spandrel wall is vertical, the wall being 1 foot 6 inches thick with a coping 1 foot deep projecting 3 inches beyond the face. Near the abutments the wall has a vertical back for a distance of 3 feet 9 inches down from top of wall, which is 6 inches below the base of rail, and a battered back (3 inches to 1 foot) from this point to the haunch of arch. The spandrel walls were anchored to the old abutments in the same manner as the new concrete abutments.

The back of the arch is waterproofed with a 1:1 concrete and sand mortar. Three 3-inch diameter drains are provided at each abutment to drain the fill.

Reinforced Concrete Arch Bridge.

The reinforced concrete arch bridge shown is a double-track structure 32 feet 6 inches wide over all, composed of one 36-foot skew span and two 32-foot skew spans with solid spandrel walls, retaining earth fill and ballast.

The arches are designed for Cooper's E-50 loading with 25 per cent impact for live loads and the dead loads of fill and arches. The arch rings were analyzed by the method of the elastic theory. The limiting stresses used were 16,000 pounds per square inch tension in steel and 650 pounds per square inch compression in concrete. Reinforcing bars used were deformed round bars, lapped 30 diameters at splices and securely tied with wire.

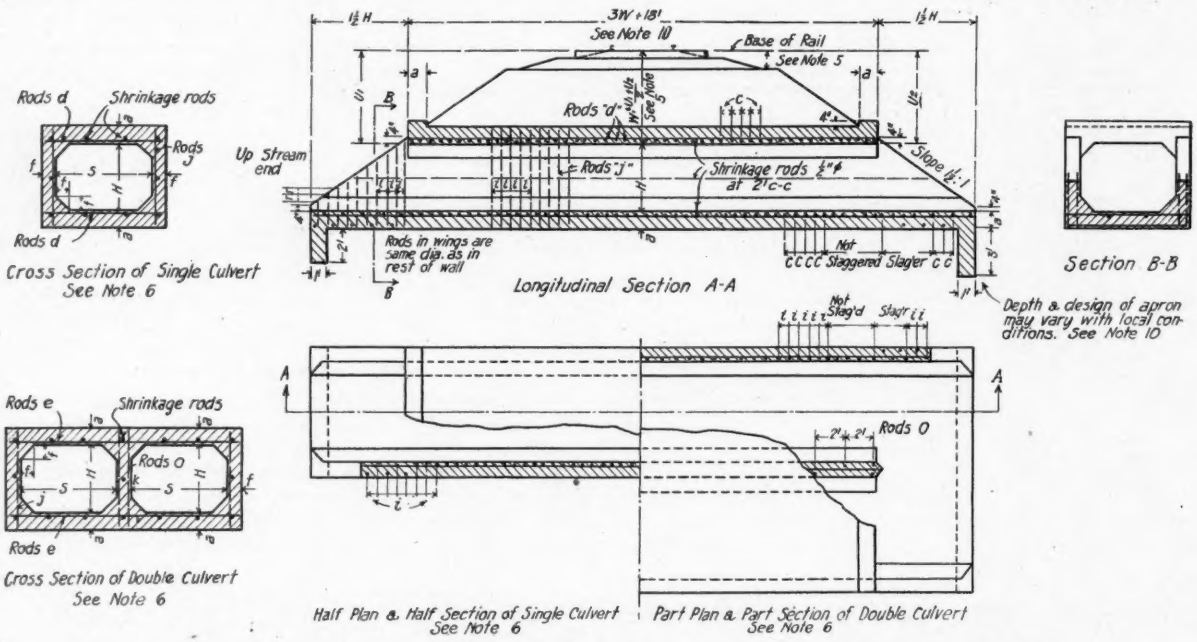
The main arch has a crown thickness of 2 feet 3 inches, while the smaller ones have a thickness of 2 feet at the crown. The arches are three-centered, with a rise of 13 feet. The center lines of piers are set on a skew of 60 degrees with the center line of bridge. The smaller arches have a clear span of 27 feet 8½ inches measured perpendicular to pier faces, and the larger has a span of 31 feet 2⅛ inches.

The piers are of plain concrete 5 feet wide and 46 feet 10 inches long under copings, with a batter of ½ inch to 1 foot on sides and ends which have circular cutwaters. Pier copings are 1 foot 6 inches deep, with beveled edges. The exposed portions of the abutments have the same appearance as the piers and were doweled to the existing masonry abutments. The wing walls on one side of the bridge are counterfort walls separated from the arches by tar paper joints. On the other side the wings are parallel to center line of bridge and consist of a facing of concrete doweled to the old masonry.

The concrete used in the footings was a 1:3:6 mixture, that in piers and abutments a 1:2½:5 mixture, while in the arch rings and spandrels a 1:2:4 mixture was used.

The arch rings are reinforced with ⅝-inch diameter deformed bars, 12-inch centers in extrados and intrados extending about 4 feet into piers and curved to fit the curves of arch rings, lapping 2 feet 6 inches at splices. The transverse reinforcement consists of ½-inch diameter bars 2-foot centers directly above and below the longitudinal bars near intrados and extrados, respectively, lapping 2 feet at splices. The longitudinal bars in intrados of adjacent arches are tied together by four sets of hook rods placed horizontal at about 1-foot centers, the first one being placed just above the top of pier. At the critical sections of the arch rings four sets of ⅜-inch diameter continuous loop stirrups (see detail) looping over longitudinal bars in extrados and intrados are spaced about 2-foot centers.

The portion of the spandrel wall below the crown of arches is a plain gravity wall with a back batter of 4 inches to 1 foot and a vertical face, anchored to the arch ring with ½-inch diameter dowels 4 feet long 2-foot centers. As originally designed the portion above this, 4 feet 11 inches high, which forms the parapet, was designed and reinforced as a cantilever wall 18 inches thick; it was built, however, as a continuation of the gravity wall below. The coping is 1 foot 6 inches deep and


Rods d
Shrinkage rods
Rods J
Up Stream end
Cross Section of Single Culvert See Note 6
Rods "d"
Rods "J"
Shrinkage rods ½"ϕ at 2'c-c
Slope 1½:1
Rods in wings are same dia. as in rest of wall
Not Staggered
Longitudinal Section A-A
Section B-B
Depth & design of apron may vary with local conditions. See Note 10
Rods e
Shrinkage rods
Rods O
Cross Section of Double Culvert See Note 6
Not Skg'd Staggered
Half Plan & Half Section of Single Culvert See Note 6
Part Plan & Part Section of Double Culvert See Note 6

Notes:- 1- Unless special permission is obtained double box culverts will be used in all cases where span is equal to or greater than twice the hight. Use of single box culverts beyond these proportions materially increases the cost.
2- Use plain round rods for reinforcements.
3- Place surface of rods 1½" from surface of concrete.
4- Use concrete with the following formula:- 1 cement, 2½ Sand, 5 Crushed rock (or gravel) Particles of crushed rock or gravel shall not exceed 1" in any dimension.
5- Distance from base of rail to top of concrete shall be not less than 12".
6- For values of W greater than 10' increase the thickness of top, bottom and side walls as follows:
1" when W equals 10' to 20'
2" " " " 20' " 30'
3" " " " 30' " 40'
4" when W is greater than 40'. Use same size, length and spacing of rods for all values of W.
7- Where piles are necessary an approved special plan shall be used.
8- Slope of culvert shall be not less than 1.0%.
9- Bevel all square corners 1".
10- Where special conditions render departure from the standard advisable the desired changes must be indicated in crayon on a blue print and submitted to the Chief Engineer Maintenance of Way for approval prior to the commencement of work.

Details for Standard Box Culverts.

projects 3 inches beyond the face of wall, the outside top edge having a chamfer of 1½ inches in 3. The top of parapet is 6 feet above the crown of the end arches and 5 feet 9 inches above the crown of the center span.

The backs of arches and spandrel walls are waterproofed with a 1:2 cement-sand mortar. Drain pipes 4 inches in diameter are placed over each pier.

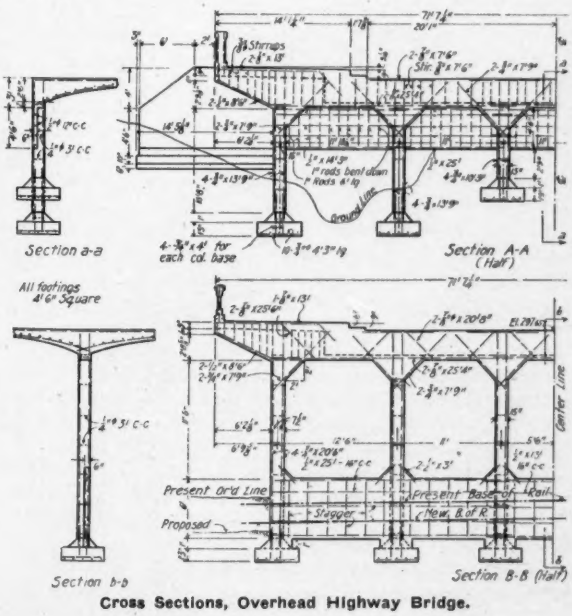
Reinforced Concrete Box Culverts.

The standard sheet for reinforced concrete box culverts reproduced here gives some valuable information as to the dimensions of walls, reinforcing and quantities contained in single and double box culverts from 3x3 feet to 14x14 feet openings for fills of not over 10 feet.

These structures are designed for Cooper's E-50 loading with impact varying from 25 to 100 per cent, depending on the depth of fill over the slab. The minimum allowable distance from base of rail to top of culvert is 12 inches. The concrete used throughout is a 1:2½:5 mixture, with crushed stone or gravel passing a 1-inch mesh for the coarse aggregate. The unit stresses used for the concrete and steel are 650 pounds per square inch in compression and 16,000 pounds per square inch tension, respectively. Plain round rods of medium steel are used as reinforcement; all reinforcement being so placed as to be 1½ inches clear from surface of concrete.

Double box culverts are used in all cases where the span is equal to or greater than twice the height, the use of single box culverts beyond these proportions materially increasing the cost.

The top and bottom slabs are made the same thickness with transverse reinforcement near the inner face and longitudinal shrinkage rods ½-inch diameter spaced at 2-foot centers, just above and below the transverse bars. The side walls are reinforced in a similar manner near the inner face. Forty-five degree fillets are placed at all corners. No negative moment reinforcement is provided at the corners of culverts. The bottom slab extends for a distance equivalent to one-half of the height at each end and terminates in a baffle wall 1 foot thick and extending at least 3 feet below the bottom of slab at the downstream end and 2 feet at the upstream. The side walls extend to the ends of bottom slab and are cut off at a slope of 1½ to 1. The cover slabs have a curb 4 inches high at each end equal in width to thickness of cover slab. The length of the cover slabs are in general made equal to three times the depth of fill plus 18 feet for single track. All square corners have a bevel of 1 inch. The slopes of culvert bottoms are made not less than 1 per cent.



Cross Sections, Overhead Highway Bridge.

The values given in the accompanying table are for values of "W" (the average depth of fill) not greater than 10 feet. For values of "W" greater than 10 feet the top, bottom and side walls are increased as follows:

1 inch when W equals 10 feet to 20 feet.

2 inches when W equals 20 feet to 30 feet.

3 inches when W equals 30 feet to 40 feet.

4 inches in all cases when W is greater than 40 feet.

The same size, length and spacing of bars are used for all values of "W," the extra strength required being furnished by the increased thickness of slabs.

Reinforced Concrete Overhead Highway Bridge.

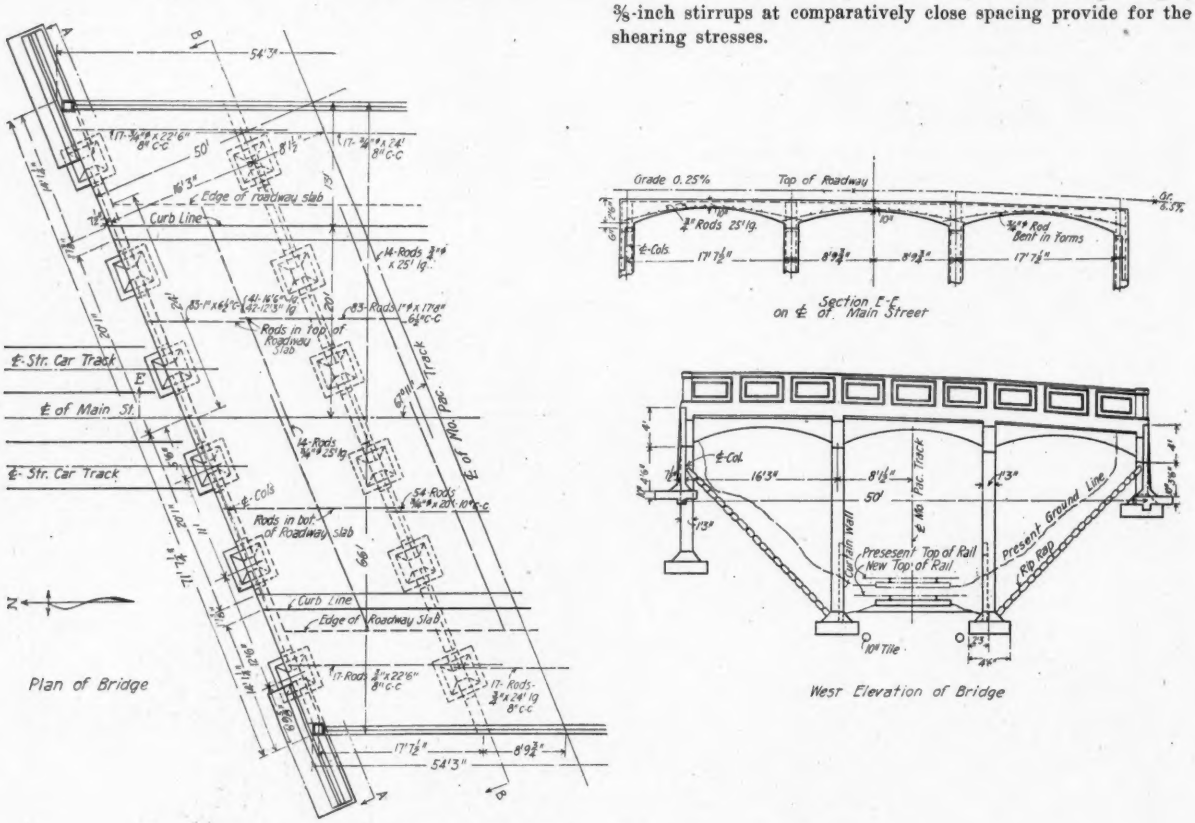
An overhead highway viaduct of the transverse girder and column type placed on a skew of over 67 degrees and designed

Table of Quantities and Dimensions for Single and Double Box Culverts.

for heavy street car loading is illustrated herewith. The length of the bridge out to out measured perpendicular to the center line of track is 50 feet and 54 feet 3 inches parallel to center line of street, while the width perpendicular to the center line of street is 66 feet, out to out, providing for a 40-foot roadway and two 13-foot sidewalks. The deck slab is carried on girders supported by four rows of columns spaced 16 feet 3 inches centers, placed parallel to the center line of tracks.

The concrete used in the entire structure was a 1:2:4 mixture. The live loadings used in design were: Street car loading, a 40-ton car on each of two tracks in positions to cause maximum stresses in the members in question; roadway slab, 20-ton road roller; sidewalk, 100 pounds per square foot, no impact; an impact of 50 per cent was used for roadway slab. Unit stresses used were same as noted for other reinforced concrete structures described.

There are six columns supporting each transverse girder, the end columns being 12 feet 6 inches centers, while the intermediate ones are 11 feet centers. The columns, 1 foot 3 inches square, are reinforced with four ¾-inch diameter vertical bars extending nearly to top of deck slab tied together with ¼-inch wire ties 3 feet centers. The column footings consist of a lower course 4 feet 6 inches square and 1 foot 3 inches deep and an upper course consisting of a frustrum of a pyramid 1 foot high, the top being 1 foot 3 inches square. Reinforcement in footings consists of five ¾-inch bars 4 feet 3 inches long in both directions. The columns next to track have a height of 17 feet 6 inches from top of footing to bottom of girder with a 2x2-foot fillet at the connection with girder. The columns at the south end of the bridge are very short, while those at the north end are 10 feet 8 inches for the two at each side and 7 feet 3 inches for the intermediate ones. The fillets are reinforced with two ¾-inch diameter bars 7 feet 9 inches long parallel to edge of fillet and extending nearly to the top of the girders.



Half Plan and Elevation, Overhead Highway Bridge.

A 6-inch reinforced concrete curtain wall 6 feet high above tops of footings is placed flush with the track face of the two intermediate rows of columns. These walls are filleted to the columns at the top. Their purpose is to protect the track from sliding earth, the surface of which being riprapped has a very steep slope. Similar walls are provided below the outer line of girders at the top of columns to retain the fill. The wing walls at the sides are designed as cantilever walls.

The intermediate girders 3 feet deep and 1 feet 3 inches wide at the bottom are reinforced with two ⅞-inch bars straight in bottom continuous over two spars and two ⅞-inch bars bent up at each end over the supports for each span, thus providing an equal amount of steel top and bottom in tension regions. At the sides the girders project 6 feet 2 inches beyond the columns as cantilevers carrying part of the sidewalk, the depth of the end of cantilever being 1 foot 3 inches. The cantilever portions are reinforced with stirrups and bent bars. The girders at ends of bridge are of the same size as intermediates, but have only half the amount of steel in top and bottom, all bars being straight, ¾-inch stirrups at comparatively close spacing provide for the shearing stresses.

The roadway slab between girders is an arched slab 2 feet 6 inches thick at the girders and 10 inches thick at the crown, the top being curved slightly. The slab is reinforced with ¾-inch diameter longitudinal bars 10 inches centers in bottom curved to fit the intrados and 1-inch diameter bars 6½ inches centers in top of slab, the bars in end spans bending down into the curtain walls and acting as vertical reinforcement. Transverse reinforcement is provided only in the bottom of the slab just above the lower longitudinal bars and the bars are spaced 1 foot centers.

The sidewalk slab is 9 inches thick and extends back 11 feet from end of cantilever support. Reinforcement in the shape of ¾-inch bent bars 8 inches centers is provided longitudinally, no transverse bars being used.

The hand railing is of thin reinforced concrete paneled slabs 3 feet 6 inches high with heavier posts at the ends. The general

appearance of the structure, that of a series of flat arches with a cantilevered sidewalk, is good and is, in fact, much better than the usual structures of this type.

Comment.

The structures just described indicate clearly that the trend of modern progress in concrete design is toward the use of reinforced concrete for nearly all structures except the possible exception of piers, the cost of which, if built of reinforced concrete would in general be prohibitive on account of the fact that weight is in general required for stability. This means that reinforced piers must be filled with earth or rock, which offsets any saving in reinforced concrete.

The different types of abutments described are especially noteworthy since they indicate how easily an economical design can be made up to fit the conditions at hand. The data on box culverts should also be of value to every engineer, the tables being unusually complete.

We are indebted to Mr. J. R. Stephens, Chief Engineer Missouri Pacific Ry., for plans and data from which this article was prepared.

New Books

TESTS OF REINFORCED CONCRETE BUILDINGS UNDER LOAD. By A. N. Talbot and W. A. Slater.—Bulletin No. 64, of the Engineering Experiment Station of the University of Illinois. Paper 6x9. 104 pages. Copies gratis on application to W. F. M. Goss, Director.

Besides giving the results of tests, this bulletin presents a detailed discussion of the methods and apparatus developed at the University of Illinois for measuring the stresses caused by floor loads in reinforced concrete building. It is shown that these stresses may be determined with a considerable degree of accuracy if care is used in making the test. The bulletin furnishes valuable information on the action of several building floors under load, and will be useful to engineers and designers of reinforced concrete structures.

REINFORCED CONCRETE BUILDINGS. By E. L. Ransome and Alexis Saurbrey. Cloth, 6x9; 235 pages; numerous cuts. Published by McGraw-Hill Book Co. New York. Price $2.50.

This book has been written primarily for the experienced engineer and for this reason ultimate results are treated in greater detail than the derivation thereof.

The book is divided into three parts, as follows: (1) A Contribution to the History of Reinforced Concrete. (2) Rational Design of Reinforced Concrete Buildings. (3) Practical Construction of Reinforced Concrete Buildings.

Part I is composed of a personal reminiscence by E. L. Ransome, which is of interest due to the fact that the author is the pioneer of the concrete industry, and a discussion on basic patents by Alexis Saubrey. The matter on patents is by no means complete, some matter referring to designs foreign to building construction having been given to the exclusion of valuable information on the latter which could have been given.

Part II is a brief theoretical analysis of reinforced concrete, omitting all intermediate steps in the development of the formula, a previous knowledge of the subject on the part of the reader being presupposed. It is our opinion that the value of the book would have been greater had the standard nomenclature for formulæ adopted by the joint committee and now used almost exclusively been used, instead of that of the authors. Considerable space is allotted to the discussion of transverse stresses and stirrups or V-bars. A tentative method of analysis of four-way reinforced flat slab floors is given, but it cannot be cited as solving the problem in a very satisfactory manner.

Part III is devoted to practical instruction. Most of the subject matter consists of a detailed description of the Ransome "unit construction" and other valuable information on other types of construction has been excluded. This is to be regretted since the merits of these other types have been omitted intentionally or otherwise to the benefit of the "unit method of construction," which it is true is very economical in many cases, but whose economical application is by no means universal.

The authors in several instances take exception to the prevailing ideas; some of these exceptions no doubt are of value, while others seem to be more or less prejudicial. The general arrangement and typography of the book is good. The book is entirely too small for the subject matter considered and as a result much information of value to the engineer is omitted. The practicing engineer will find in this work many things not published elsewhere, but it cannot be recommended for the student or young designer without experience.

THE CONCRETE HOUSE AND ITS CONSTRUCTION. By Maurice M. Sloan. Cloth, 6 x 9 in., 224 pages, illustrated. Published by Association of American Portland Cement Manufacturers; Percy H. Wilson, secretary; Land Title Bldg., Philadelphia. Price, $1.00. Special price of 14 cents to architects.

Although this is a book on concrete dwellings, it will no doubt appeal to the railroad architect who desires to give large and small passenger stations the individuality which is only possible with concrete. The use of concrete for stations is constantly increasing and it behooves every railroad architect and engineer to fully acquaint himself with the vast possibilities which are so forcibly set forth in this little volume.

The book does not treat of the subject in a superficial way but goes into the details of construction and it should therefore be of practical value to the architect.

INSPECTION OF CONCRETE CONSTRUCTION. By Jerome Cochran. 6 x 9 in., cloth, 595 pages. Published by Myron C. Clark Pub. Co., Chicago, Ill. Price, $4.00.

This book contains practical hints for concrete inspectors, superintendents and others engaged in concrete construction. From the title and size of the book one would expect it to contain detail information on all branches of concrete construction; this, however, is not entirely the case, since the detailed inspection of bridges, walls and other railroad structures is not treated as extensively as are other branches. From the text the reader soon becomes aware of the fact that the author's experience has been mainly in concrete building construction and the treatment of this subject is very extended and complete. Had the subject of detailed inspection of bridges, walls, tanks, grain elevators, docks, etc., been included to the exclusion of some lengthy discussions of less important matters, the book would have had a broader field and would have been much more valuable to the young engineer and inspector.

The introduction sets forth the need of inspection and the duties of the inspector. The first two chapters treat of the inspection of hydraulic cement, sand, stone and miscellaneous concrete materials. The chapter on cement testing and inspection is an elaboration of the standards adopted by the American Society for Testing Material. The second chapter is unusually complete, due emphasis being placed on the need of testing sand, stone, and water used for concrete. Chapter 3 on the inspection of proportioning and mixing of concrete will prove valuable to the young inspector and also the older man who wishes information on methods of proportioning. The next chapter, on the inspection of forms, molds, centering and falsework, is much more complete than is found in other books of this character. The portion on arch centers, however, omits entirely the subject of steel truss centering and allied types of steel centers, which are being used quite extensively nowadays. In fact, the entire matter of steel forms and centering is somewhat slighted. The inspection of steel reinforcement treats almost entirely of this subject as related to building construction. A chapter of about 100 pages on the inspection of concreting is very complete, covering the work of concreting in all its phases in a most commendable manner. The in-

spection of the various kinds of surface finish is treated very thoroughly.

The waterproofing of concrete structures has not been heretofore treated to any great extent in books on concrete and it is gratifying to note that Mr. Cochran has given a full treatment of the various methods of waterproofing. The inspection of concrete sidewalk, curb and pavement construction and various concrete products, such as ornamental concrete, concrete blocks, fence posts, railroad ties and sewer pipe, is treated in two chapters. The final chapter on molding and driving concrete piles is valuable in view of the fact that the use of concrete piles is becoming very extensive. The book closes with a glossary of terms used in concrete construction, a list of authorities consulted, and a good index, which is essential in a work of this character.

Taken as a whole, with some exceptions however, the book is to be highly commended, most subjects being treated in a most exhaustive manner. If in future editions the portions not very fully treated in this first edition are rounded out, the book will soon be the standard work on the subject. The typography and composition are excellent. A feature which is to be commended is the use of heavy type paragraph headings which in a few words summarize what is treated in the paragraph and make the finding of individual subjects very easy.

MODERN ORGANIZATION. By Charles De Lano Hine. Board, 5x7 in., 110 pages. Published by The Engineering Magazine Co., New York. Price, $1.50.

Anyone interested in the subject of organization, and especially in its finer points, cannot help but be impressed by the extensive research and experience with the subject, which is evident in the pages of this volume. While there are many who may disagree with Mr. Hine in his conclusions, there are few, and probably none, who have gone into the subject so thoroughly.

Proper organization, in other words *real* organization, are sadly lacking on some of our railway systems, from the important down to the minor officers and laborers. The principles and underlying proper organization should be the same for the shop or section foreman in handling his men, as for the president of the road in handling his subordinates.

It is extremely difficult for some officials to see why they should not reverse a subordinate's orders to his men, and this is the cause of destroying many a good organization. There are times when orders should be reversed, but they should be reversed by the person issuing them, if possible or practicable. Many times there appear to reasons for the higher officer to reverse orders, which disappear when the conditions are explained. In other words, lack of *real* organization leads to interference with discipline and with work. And where there is weak organization, there will be found continual interference among employes; and correspondingly, a lesser amount of real work accomplished.

Mr. Hine's book describes and shows reason for the adoption of the Harriman lines' unit system of organization. It is extremely interesting, outlining as it does the fundamentals clearly, following with detailed discussion of the workings of the system.

The first chapter deals with the primitive forms of organization and the evolution of organization to the present day. Reasons are given for unification of the offices of different departmental officials, with one common office file, and also for the elimination of the chief clerk as a power in railway affairs. No chief clerk, be he ever so broad-minded, should be allowed to hold the authority now frequently accorded him, unless he be a man of technical and practical experience in the field in which he works. This chapter also appeals for the more considerate treatment of men, which is assuredly in line with present practice.

Chapter II explains in detail the operation of the unit system. The effect of the extent of territory covered is dwelt on, showing where the abuses of the chief clerk system occur. Under the unit system the authority of the chief clerk is reduced to that actually and accurately represented by his office —for he is not allowed to sign another's name to any papers. The consolidated file is said to be a means of saving a half million letters yearly on the Harriman system. A most notable feature is the increased availability of the officials for outside work, the large number of qualified assistants making it possible for each one to do much more line work, which it is conceded, is vitally necessary.

In the third chapter, the effect of broadening out the authority of the different officials is discussed, and the statement is made that in practically all cases the increased authority has been handled judicially. The effect of this broadening of authority is to gradually eliminate departmental jealousies, which are potent causes of interference and consequent loss of efficiency.

Over-specialization is treated in the fourth chapter. This is indeed a live question and has recently called forth much comment and warning from those eminent in their professions.

Chapter V shows the fallacy of judging efficiency entirely by statistics or accounts. It is practically impossible for an office man to properly correlate and analyize cost accounts, as he is unable to appreciate the greatly varying conditions affecting same. There is need for co-operation between the operating and accounting officers and the unit system provides for this by making the accountant a division officer.

The over-centralization of purchasing power is given a well-merited criticism. This chapter goes into detail in explaining the fallacy of this policy; no argument is necessary to prove that practical men who use tools and materials should have a strong voice in their selection and specification.

The interchanging of line and staff duties are treated in Chapter VII. The advantages of having an office man well posted on outside work is dwelt on; the practical man grasps the importance of this fact immediately. The interchanging of line and staff duties, which is promoted in this organization, certainly tends toward a better understanding between field and office, and toward the broadening of the individual official.

Chapter VIII. shows wherein many organizations are simply accidental, or evolutional, with no set underlying principles. The result of such organization, or lack of organization, is chaos.

The book "Modern Organization" is probably the most comprehensive ever written on the subject of railway organization. It should be read by every railway employe and official. It is not to be assumed, however, that blind obedience to the principles given will result in a highly developed organization. The book, however, furnishes much food for reflection and gives an excellent exposition of the principles underlying the science.

The Alabama, Tennessee & Northern is building a steel and galvanized iron general repair shop 110 ft. x 165 ft., with concrete foundations, at York, Ala. The Decatur Bridge Co. has been given a contract for the superstructure, and the foundation work is being carried out by the railway company's forces.

The Baltimore & Ohio has contracted with the American Bridge Co. for 3,000 tons of steel for a bridge at Glenwood, Pa.

The Chicago & Northwestern has awarded a contract to Jos. McCarty, of Kaukauna, Wis., for the construction of concrete bridges at several points in northern Wisconsin and Michigan.

The Cleveland, Cincinnati, Chicago & St. Louis will enlarge its shops at Linndale, Ohio, a suburb of Cleveland, by the erection of a new car repair shop and an engine house. The H. A. Peters Co., of Chicago, Ill., has been awarded the general contract for construction work. The structural iron work will be erected by the Sprague Iron Works, Chicago.

The Signal Department

SINGLE-TRACK BLOCK SIGNALING ON THE CHICAGO & NORTH-WESTERN RAILWAY.

The Chicago & North-Western Railway completed during the last year its first block signaling on single track. The section of road protected is between Harvard, Ill., and Evansville, Wis. Except for a stretch of about five miles between South Janesville and Janesville, which is double track, the signal protection is arranged for "absolute-permissive" operation.

The double track, of course, is protected in the usual manner. The total length of single track under this type of block signaling is about 35 miles, and was the first installation of its kind in the United States, when it was put in service.

Under the "absolute-permissive" operation of signals, the protection obtained, for opposing moves, is from station to station, while for following moves the signals clear up the same as for double track. The out-bound signals at stations are home signals having vertical lights, and when such signals are at "stop" a train cannot proceed unless permission is given by the train dispatcher to do so, unless the train proceeds under flag protection to the next caution or clear signal. The other signals between stations are block signals with diagonal lights, and when the "stop" indication is displayed, a train can not proceed after stopping unless it has approached the block signal under flag from a home signal; in the latter case the train need not stop. A dispatcher's telephone is placed at each home signal.

The diagram, Fig. 1, besides showing the track layout and signal locations, shows the signal controls for both following and

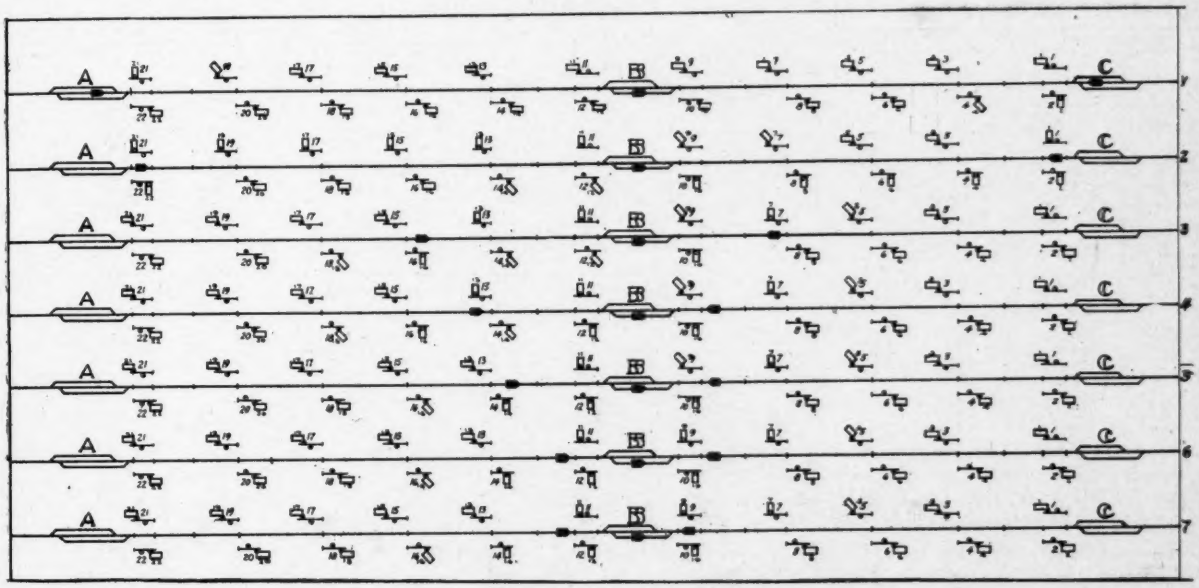


Fig. 2.

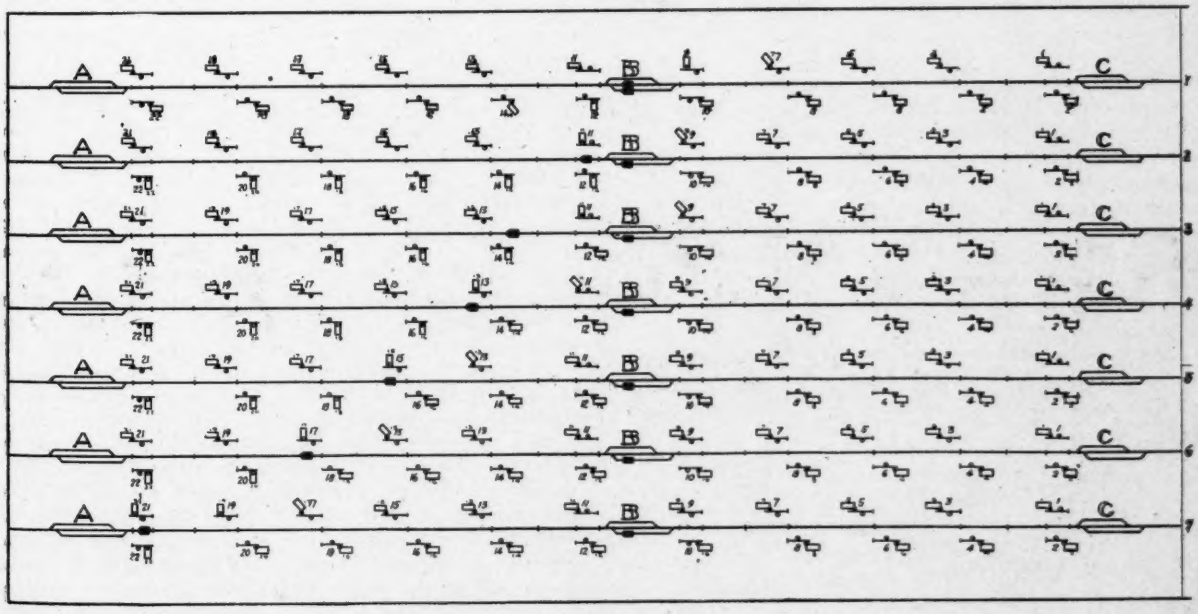


Fig. 3.

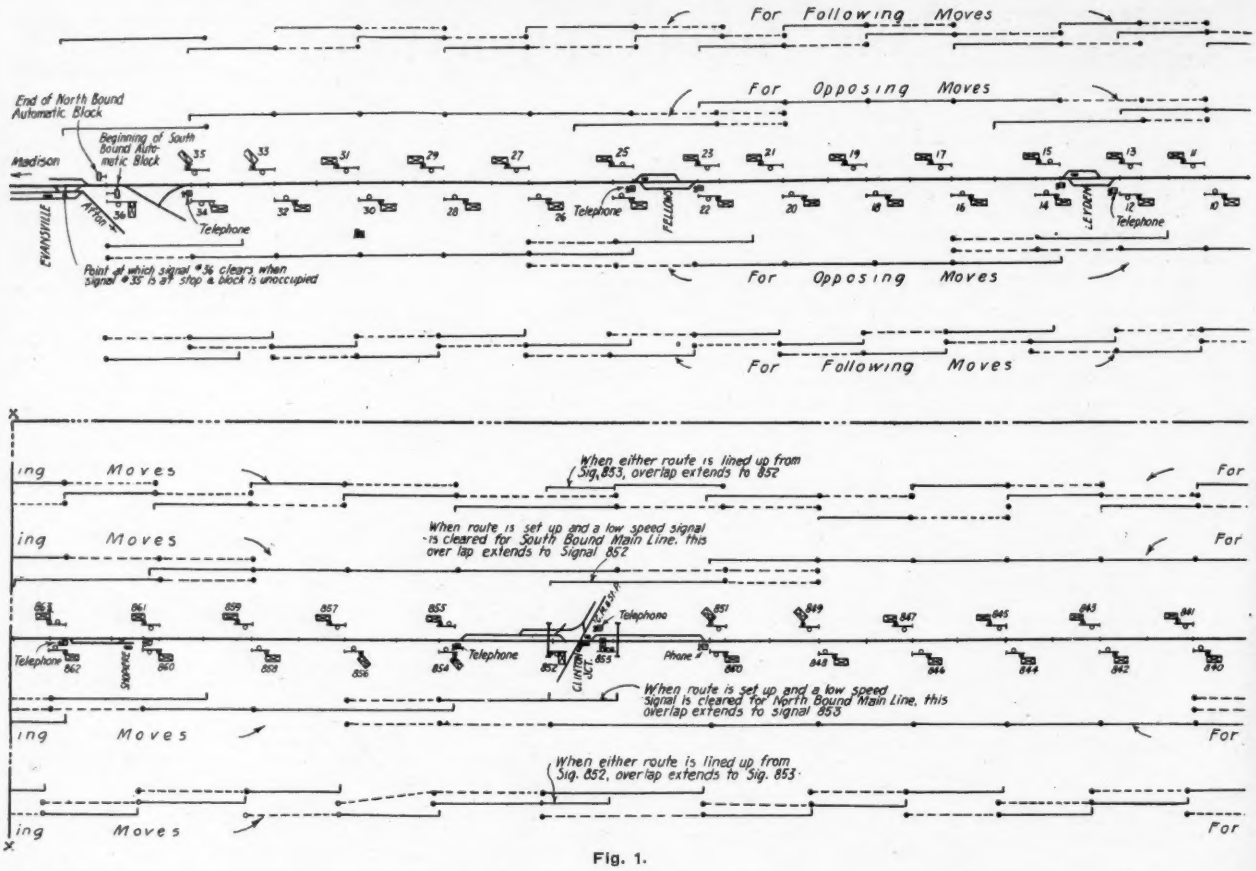

For Following Moves
For Opposing Moves
End of North Bound Automatic Block
Beginning of South Bound Automatic Block
Madison
Telephone
Fellows
Point at which signal #36 clears when signal #35 is at stop & block is unoccupied
For Opposing Moves
For Following Moves
When either route is lined up from Sig. 853, overlap extends to 852
When route is set up and a low speed signal is cleared for South Bound Main Line, this over lap extends to Signal 852
Telephone
When route is set up and a low speed signal is cleared for North Bound Main Line, this overlap extends to signal 853
When either route is lined up from Sig. 852, overlap extends to Sig. 853

Fig. 1.

opposing moves. These controls are indicated by the full and dash lines. The full lines show the beginning and end of the stop indication, while the dash lines together with the full lines show the beginning and end of the caution indication.

When a train enters the stretch of track between any two sidings it sets all of the signals for the opposing direction to stop between the two sidings. For example, in Fig. 1, suppose a train leaves Leyden headed toward Fellows; as soon as the train enters the section of track between signals 14 and 15, all of the opposing signals—14, 16, 18, 20 and 22—are set to stop, and signals 24 and 26 will indicate caution. As the train proceeds and passes signal 17, signal 15 will clear to the caution position and will remain so until train passes signal 19, at which time signal 15 will assume the clear position. The same is true for signal 17, that is, it will indicate the caution position when train passes signal 19, and remain so until train passes signal 21, at which time signal 17 will indicate clear. In like manner, signals 19, 21, 23, etc., will assume the caution and clear positions as the train proceeds. When the train reaches the ent section between signals 21 and 23, signal 24 will be set to stop and signal 26 will still be at caution. Figs. 2 and 3 illustrate the operation of the signals as has just been explained. Plans like Figs. 2 and 3 were prepared for the education of the trainmen in this new system of signaling, and show very nicely the signal indications displayed and the protection provided for trains approaching a meeting point, and for following moves.

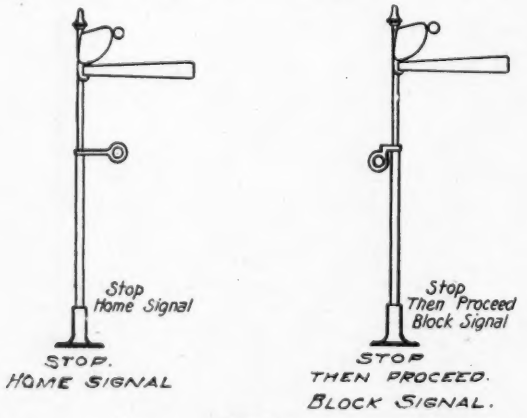


Fig. 4.

The circuits necessary for the operation of this type of signaling are the same as for double track with the addition of stick relays, which serve as selectors for the direction in which the train is running; that is, they will be energized for those signals which govern in the same direction as the train is running, and de-energized for those signals which govern in the opposite direction. The picking up of a stick relay at any signal location is accomplished whenever a signal drops from 90° to 45°, and the track relay at the signal is de-energized. The circuit for a stick relay through the circuit breaker on a signal is open between 45° and 0°; hence an opposing stick relay cannot pick up when a train approaches because the opposing signal will be at 0° long before the track relay at the opposing signal is de-energized. However, there must be at least two track circuits between opposing signals.

After the stick relays are once picked up they stick up through a back point of the 45° control relays, and will consequently stay up through the block. Each 45° control relay passes through a front point of the 45° control relay at the next signal ahead, and also through a front point of the stick relay at the same signal in multiple, so that if the stick relay is down, each 45° control relay when de-energized drops the next 45° control relay, and so on to the next home signal. But if the

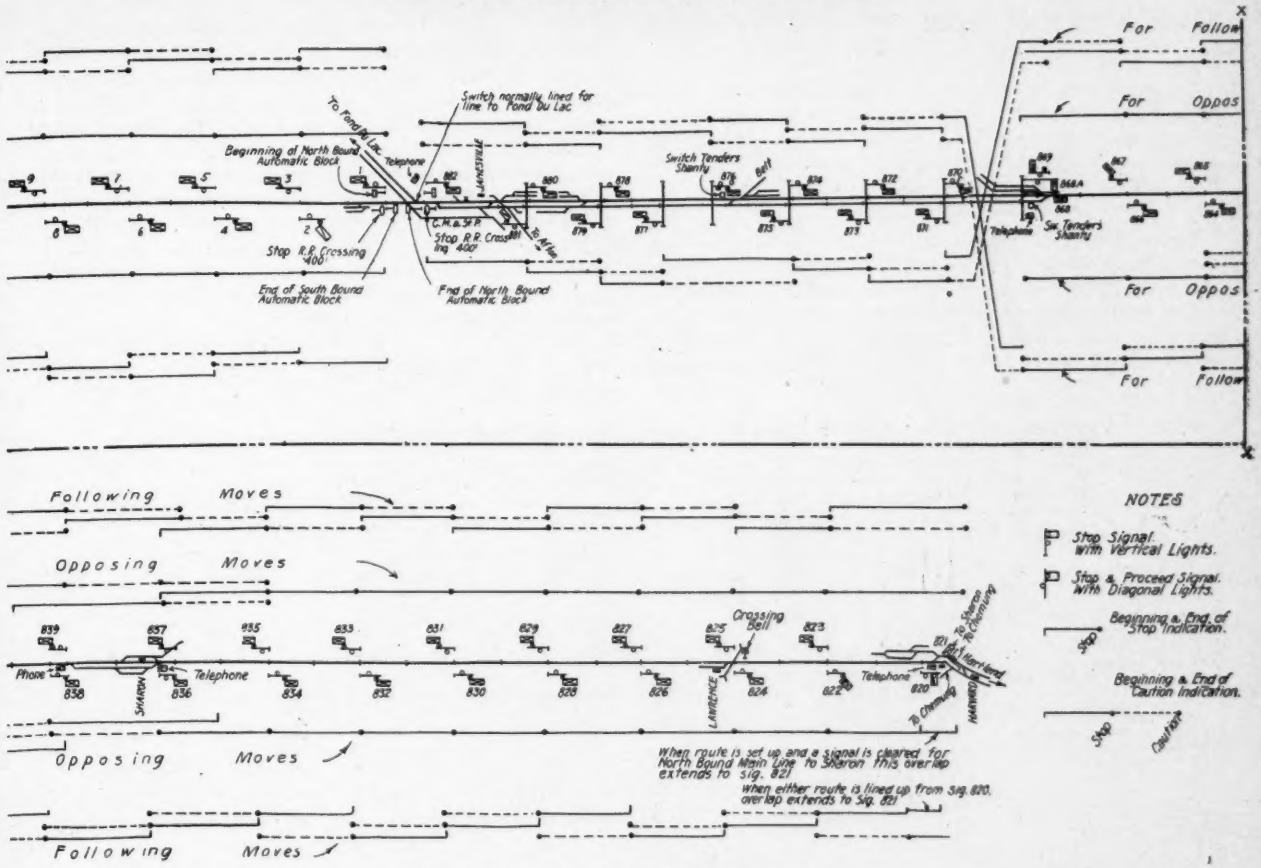

Switch normally lined for line to Fond du Lac
To Fond du Lac
Beginning of North Bound Automatic Block
Telephone
Switch Tenders Shanty
Stop R.R. Crossing 400'
End of South Bound Automatic Block
End of North Bound Automatic Block
Telephone
Sw. Tenders Shanty
For Follow
For Oppos
For Oppos
For Follow
Following Moves
Opposing Moves
Crossing Bell
Phone
Telephone
Telephone
Opposing Moves
Following Moves
When route is set up and a signal is cleared for North Bound Main Line to Sharon this overlap extends to sig. 821
When either route is lined up from sig. 820, overlap extends to Sig. 821
NOTES
Stop Signal with Vertical Lights.
Stop & Proceed Signal. With Diagonal Lights.
Beginning & End of Stop Indication.
Beginning & End of Caution Indication.

Fig. 1. (Continuation from Opposite Page.)

stick relay is up, the 45° control relay has no effect on the next. In this way the opposing signals between two stations are dropped to the stop position.

The signal aspects are shown in Fig. 4. One shows a home signal at "stop," with vertical lights; the other a block signal at "stop," with diagonal lights. The night indications are red for "stop," red and green for "caution" and green for "clear." Marker lights are lunar white.

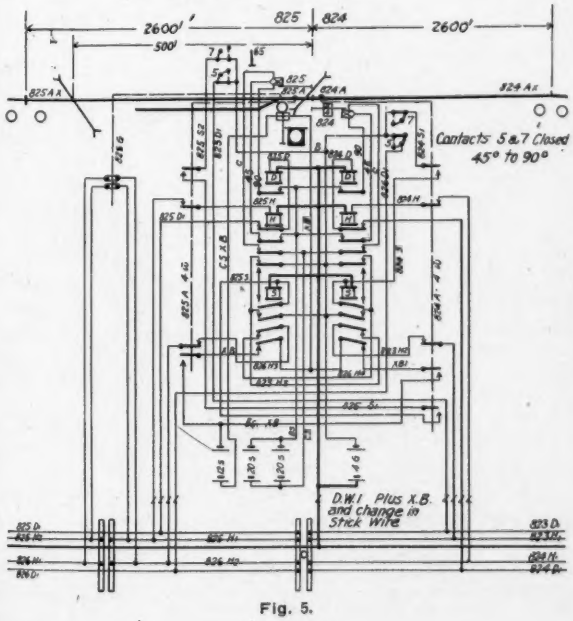


Fig. 5.

The operation of the crossing bell at Lawrence, Ill., near the double signal location 824-825, is quite interesting. Referring to Fig. 5, showing the wiring diagram of the double signal location, and the crossing bell: note that the bell is not rung in the usual manner, by means of an interlocking relay, but by employing the stick relays and ordinary track relays required for the signal system. The operation is as follows: When a train enters the track section from either direction, the track relay drops and the bell rings through a back point of the track relay, and a back point of the stick relay. The bell stops ringing in the usual manner, that is, when the train passes the bell, because the other stick relay picks up and opens the bell circuit. This feature controls the bell perfectly.

This scheme of "absolute-permissive" operation, and the circuits for its control, were designed by the General Railway Signal Company, which had the contract for this installation under the supervision of J. A. Peabody, signal engineer of the Chicago & North-Western Railway. We are indebted to the latter for the information and illustrations appearing in this article.

Personals

J. C. Mill, formerly assistant signal engineer, has been appointed signal engineer of the Chicago, Milwaukee & St. Paul Ry. at Milwaukee, Wis., succeeding A. Brown, deceased.

R. C. Toombs has been appointed signal supervisor of the Southern Pacific Co. at Ogden, Utah, succeeding J. E. Lyon. Mr. Toombs entered the service of this railway in 1903 and has been with them continuously since that date.

BLOCK SIGNALS ON THE RAILROADS OF THE UNITED STATES, JANUARY 1, 1913.

The accompanying tables have been compiled from reports made by railroad companies in response to the commission's order of September 19, 1912. Table No. 1 shows the aggregate length of railroad line of each company reporting on which the block system was in use on January 1, 1913; Table No. 2 indicates the kinds of automatic signals used.

The total length of road in the United States operated under the block system on January 1, 1913, was 83,949.8 miles. Of this total, 22,218.8 miles were automatic and 61,731 miles were non-automatic. There was an increase of 1,883.9 miles in the length of road operated by the automatic block system, and an increase of 5,656.2 miles in the length of road operated by the non-automatic block system over the figures shown in the bulletin of January 1, 1912. The total increase in the mileage of road operated by the block system during the year was 7,540.1 miles.

The Atchison, Topeka & Santa Fe and the Chicago, Rock Island & Pacific operate jointly 11.8 miles of single track equipped with automatic block signals. The Atchison, Topeka & Santa Fe and the Southern Pacific operate jointly 67.3 miles of single track equipped with automatic block signals.

The Atlanta & West Point and the Central of Georgia operate jointly 6 miles of double track equipped with automatic signals, each company owning one track; in these tables this mileage is shown as double track for both companies.

The Chicago, Burlington & Quincy and the Chicago, Milwaukee & St. Paul operate jointly 10.8 miles of double track equip-

AGGREGATE LENGTH OF LINES AND PARTS OF LINES ON WHICH THE BLOCK SYSTEM WAS IN USE ON JAN. 1, 1913.

Names of railroads.	Automatic block signals.						Nonautomatic block signals.						Total automatic and nonautomatic.		Total passenger lines operated.		Percentage block signaled, miles of track.
	Single track.	Double track.	Three track.	Four track.	Total. Miles of road.	Total. Miles of track.	Single track.	Double track.	Three track.	Four track.	Total. Miles of road.	Total. Miles of track.	Miles of road.	Miles of track.	Miles of road.	Miles of track.	
Albany Southern	0.5				0.5	0.5	26.7	16.3			43.0	59.3	43.5	59.8	43.5	59.8	100.0
Ann Arbor							1.0				1.0	1.0	1.0	1.0	292.0	292.0	.3
Arizona & New Mexico	1.0				1.0	1.0							1.0	1.0	109.0	109.0	.9
Atchison, Topeka, & Santa Fe:[1]																	
Eastern Lines	22.2	113.7			135.9	249.6	488.1	495.5			983.6	1,479.1	1,119.5	1,728.7	2,491.2	3,119.5	55.4
Western Lines		2.5			2.5	5.0	552.8	23.8			576.6	600.4	579.1	605.4	2,959.0	2,985.3	20.3
Coast Lines	74.3	53.2			127.5	180.1	4.3				4.3	4.3	131.8	184.4	1,940.8	2,134.8	8.6
Gulf, Colorado & Santa Fe	3.6				3.6	3.6							3.6	3.6	1,668.8	1,668.8	.2
Atlanta & West Point								6.0			6.0	12.0	6.0	12.0	86.0	92.0	13.0
Atlantic Coast Line	2.4	51.1			53.5	104.6	331.9	105.5			437.4	536.1	490.9	640.7	3,822.8	3,960.4	16.2
Auburn & Northern	6.5				6.5	6.5							6.5	6.5	6.5	[6] 6.5	100.0
Baltimore & Ohio	14.7	266.7	4.8	16.8	303.0	635.4	1,906.6	718.5	107.0	7.5	2,799.6	3,761.9	3,102.6	4,397.3	3,102.6	4,397.3	100.0
Baltimore & Ohio Chicago Terminal	1.2	14.3			15.5	29.2							15.5	29.2	45.0	72.2	40.4
Baltimore & Ohio Southwestern		24.9			24.9	49.7	901.4	36.5			937.9	974.4	962.8	1,024.1	962.8	1,024.1	100.0
Baltimore & Sparrow's Point							1.7	3.0			4.7	7.7	4.7	7.7	4.7	7.7	100.0
Bessemer & Lake Erie[2]							64.4	130.0			194.4	324.4	194.4	324.4	191.0	320.9	97.2
Boston & Maine[3]	410.4	619.7		2.1	1,032.2	1,658.2							1,032.2	1,658.2	2,219.8	2,773.4	59.8
Boston, Revere Beach & Lynn		13.8			13.8	27.6							13.8	27.6	13.8	27.6	100.0
Buffalo, Rochester & Pittsburgh	2.0	35.1			37.1	72.2	311.7	96.5			408.2	504.5	445.3	576.7	445.3	576.7	100.0
Butte, Anaconda & Pacific	7.9				7.9	7.9							7.9	7.9	25.3	25.3	31.2
Carolina & Northwestern							6.1				6.1	6.1	6.1	6.1	133.5	133.5	4.5
Central New England[4]	18.9	17.5			31.4	49.0	1.5				1.5	1.5	32.9	50.5	276.9	311.1	16.2
Central of Georgia	13.0	165.5	2.4	31.5	212.4	477.2	66.5	7.4			73.9	81.3	73.9	81.3	1,767.3	1,774.7	4.6
Central of New Jersey													212.4	477.2	464.1	742.9	64.2
Central Vermont							396.3	6.2			402.5	408.7	402.5	408.7	402.5	408.7	100.0
Chesapeake & Ohio		454.6			454.6	909.2	1,112.3	21.2			1,133.5	1,154.7	1,588.1	2,063.9	1,612.4	2,088.2	96.3
Chesapeake & Ohio Ry. of Indiana							262.2				262.2	262.2	262.2	262.2	262.2	262.2	100.0
Chicago & Alton	420.7	184.6			605.3	789.9	141.2				141.2	141.2	746.5	931.1	1,025.2	1,209.8	72.8
Chicago & Eastern Illinois		106.2			106.2	212.4	245.0	79.2			324.2	403.4	430.4	615.8	972.7	1,170.3	52.7
Chicago & North Western[5]	39.2	764.5	14.9	7.7	826.3	1,793.0	2,712.1	92.5			2,804.6	2,897.1	3,630.9	4,690.1	7,132.8	8,203.3	57.2
Chicago & Western Indiana		19.5			19.5	39.0		4.6	3.2		7.8	18.8	27.3	57.8	27.3	57.8	100.0
Chicago, Burlington & Quincy[6]	44.6	43.6	4.2	5.4	97.8	166.0	895.5	694.9	14.5		8,604.9	9,328.8	8,702.7	9,494.8	8,378.0	9,170.0	100.0
Chicago Great Western	196.9	86.2			283.1	369.3	88.6				88.6	88.6	371.7	457.9	1,470.7	1,566.7	29.2
Chicago, Indianapolis & Louisville	161.9				161.9	161.9	363.0				363.0	363.0	524.9	524.9	578.0	578.0	90.9
Chicago Junction							1.3				1.3	1.3	1.3	1.3	11.8	163.7	.8
Chicago, Milwaukee & St. Paul	2.4	103.7			106.1	209.8	2,909.8	493.1			3,402.9	3,894.9	3,509.0	4,104.7	6,589.4	7,175.8	57.2
Chicago, Milwaukee & Puget Sound	363.1				363.1	363.1	1,535.1				1,535.1	1,535.1	1,898.2	1,898.2	1,953.1	1,953.1	97.1
Tacoma & Eastern							172.8				172.8	172.8	172.8	172.8	172.8	172.8	100.0
Chicago, Peoria & St. Louis Ry. of Ill.	1.3				1.3	1.3	247.2				247.2	247.2	248.5	248.5	248.5	248.5	100.0
Chicago, Rock Island & Pacific	653.3	283.1			936.4	1,219.5	997.7				997.7	997.7	1,934.1	2,217.2	6,674.1	6,953.3	31.9
Chicago, Rock Island & Gulf	32.6				32.6	32.6							32.6	32.6	466.0	466.0	7.0
St. Paul & Kansas City Short Line							112.5				112.5	112.5	112.5	112.5	117.7	117.7	95.6
Chicago, St. Paul, Minneapolis & Omaha	22.5	90.4			112.9	203.3	494.0	53.3			547.3	600.6	660.2	803.9	1,571.8	1,724.6	46.6
Chicago, Terre Haute & Southeastern	1.5				1.5	1.5							1.5	1.5	351.0	367.6	.4
Cincinnati, Hamilton & Dayton	19.2	17.1			36.3	53.4	352.7	29.5			382.2	411.7	418.5	465.1	527.9	579.5	80.3
Cincinnati, Indianapolis & Western							283.9				283.9	283.9	283.9	283.9	360.9	360.9	78.6
Colorado Midland							2.0				2.0	2.0	2.0	2.0	261.1	261.1	.8
Columbia & Puget Sound	10.0	8.9			18.9	27.8							18.9	27.8	50.8	61.2	45.4
Cornwall & Lebanon							8.3	13.7			22.0	35.7	22.0	35.7	22.0	35.7	100.0
Cumberland & Pennsylvania							4.3		3.0		7.3	13.3	7.3	13.3	31.3	37.3	36.2
Cumberland Valley	7.6	47.4			55.0	102.4	90.5				90.5	90.5	145.5	192.9	162.1	216.6	89.1
Delaware & Hudson	164.2	225.2	4.3	17.5	411.2	697.6		34.6			34.6	69.2	445.8	766.8	743.9	1,042.4	73.6
Delaware, Lackawanna & Western	224.3	449.1	50.5	10.6	734.5	1,316.3	4.3				4.3	4.3	738.8	1,320.6	985.0	1,584.4	46.6
Denver & Rio Grande							7.7				7.7	7.7	7.7	7.7	2,247.3	2,406.7	.3
Duluth & Iron Range[7]		15.7			15.7	17.1							15.7	17.1	200.0	271.3	6.4
Durham & Southern							56.0				56.0	56.0	56.0	56.0	56.0	56.0	100.0
Elgin, Joliet & Eastern	2.0	3.0			5.0	8.0	11.0				11.0	11.0	16.0	19.0	211.2	270.1	4.1
Erie	4.5	234.9		14.8	254.2	533.5	500.9	545.7			1,046.6	1,592.3	1,300.8	2,125.8	1,704.4	2,529.4	84.4
Chicago & Erie							228.4	20.4			248.8	269.2	248.8	269.2	248.8	269.2	100.0
Columbus & Erie							12.6	9.8			22.4	32.2	22.4	32.2	22.4	32.2	100.0
Erie & Jersey		42.3			42.3	84.6							42.3	84.6	Freight Line.		
Genesee River							32.6				32.6	32.6	32.6	32.6	32.6	32.6	100.0
New Jersey & New York	12.5	10.5			23.0	33.5	13.6				13.6	13.6	36.6	47.1	51.9	62.4	75.5
New York, Susquehanna & Western and Wilkesbarre & Eastern							32.0	13.7			45.7	59.4	45.7	59.4	194.5	208.2	28.5
Grand Trunk	1.1	78.2			79.3	157.5	807.6	243.5			1,051.1	1,294.6	1,130.4	1,452.1	1,130.4	1,452.1	100.0
Great Northern	9.9	162.0			171.9	333.9	308.2				308.2	308.2	480.1	642.1	7,452.4	7,653.6	8.4
Hocking Valley							138.4				138.4	138.4	138.4	138.4	338.0	338.0	40.9

[1] (Atchison, Topeka & Santa Fe.) 75.9 miles of road on which automatic signals are installed in manual block territory not shown in these tables.

[2] (Bessemer & Lake Erie.) The figures shown include 8.9 miles of single-track road on which no passenger trains are operated.

[3] (Boston & Maine.) 4.8 miles of double track in Hoosac Tunnel equipped with automatic signals; part of the time this tunnel is operated as a single-track line; then the staff system is used.

[4] (Central New England.) 12.9 miles on which both automatic and nonautomatic block signals are installed shown only under automatic signals in this table.

[5] (Chicago & North Western.) Illinois Central; Long Island; New York, New Haven & Hartford; Pennsylvania; Southern Pacific; Washington Terminal: Include road with more than four tracks.

[6] (Chicago, Burlington & Quincy.) On 480.1 miles of road on which only one engine is in regular service, the block system is used whenever more than one engine is used, the rules and practices being such that the block system is introduced on the simple knowledge of an additional train being in service.

[7] (Duluth & Iron Range.) Automatic signals are installed on one track only on 14.3 miles of double-track line.

ped with automatic signals, each company owning one track; in these tables this installation is shown as double track for both companies.

The Illinois Central and the St. Louis & San Francisco operate jointly 35 miles of single track equipped with automatic signals. The Illinois Central and the Mobile & Ohio operate jointly 4.7 miles of double track equipped with automatic signals, each company owning one track; this installation is shown as double track for both companies.

The Northern Pacific and the Great Northern operate jointly 60.3 miles of double track equipped with automatic signals; each company owns one track, but the signals are owned and maintained by the Northern Pacific. This mileage is shown in these tables as double track for both companies.

AGGREGATE LENGTH OF LINES AND PARTS OF LINES ON WHICH THE BLOCK SYSTEM WAS IN USE ON JAN. 1, 1913—Continued.

Names of railroads.	Automatic block signals.						Nonautomatic block signals.						Total automatic and nonautomatic.		Total passenger lines operated.		Percentage block signaled, miles of track.
	Single track.	Double track.	Three track.	Four track.	Total.		Single track.	Double track.	Three track.	Four track.	Total.						
					Miles of road.	Miles of track.					Miles of road.	Miles of track.	Miles of road.	Miles of track.	Miles of road.	Miles of track.	
Hudson & Manhattan [1]	3.0	7.9			10.9	18.8							10.9	18.8	10.9	18.8	100.0
Illinois Central	83.6	263.3		26.3	403.2	805.4	11.0				11.0	11.0	414.2	816.4	4,432.1	5,218.5	15.6
Yazoo & Mississippi Valley	6.6				6.6	6.6		7.9			7.9	14.3	14.5	20.9	1,193.0	1,200.7	1.7
Illinois Traction	82.3	1.5			83.8	85.3							83.8	85.3	443.1	452.6	18.8
Kanawha & Michigan	1.8				1.8	1.8	2.3				2.3	2.3	4.1	4.1	163.9	163.9	.3
Kentucky & Indiana Bridge & R. R. Co.							3.0	8.2			11.2	19.4	11.2	19.4	11.2	19.4	100.0
Kentwood & Eastern							3.3				3.3	3.3	3.3	3.3	30.0	30.0	11.0
Lackawanna & Wyoming Valley							1.0	2.4			3.4	5.8	3.4	5.8	22.6	43.3	13.2
Lehigh & New England	.7				.7	.7							.7	.7	67.2	67.2	1.0
Lehigh Valley	14.1	446.3	34.8	24.0	519.2	1,107.1	648.4	58.8			707.2	766.0	1,226.4	1,873.1	1,215.3	1,862.0	100.0
Long Island	4.0	92.2	3.3	12.4	111.9	251.7	5.0	9.1			14.1	23.2	126.0	274.9	359.3	531.9	51.9
Louisville & Nashville [2]	79.1	18.0			97.1	115.1	148.1	65.5			213.6	279.1	310.7	394.2	4,467.8	4,639.4	8.6
Maine Central	437.2	62.2			499.4	561.6							499.4	561.6	1,115.5	1,173.9	47.8
Portland Terminal	4.0	11.5			15.5	27.0							15.5	27.0	18.3	28.7	94.0
Minneapolis & St. Louis							11.3				11.3	11.3	11.3	11.3	1,537.4	1,547.3	.7
Minneapolis, St. Paul & Sault Ste. Marie							1,411.0	4.4			1,415.4	1,419.8	1,415.4	1,419.8	3,497.2	3,501.6	40.6
Missouri, Kansas & Texas	9.1	1.4			10.5	11.9	9.5				9.5	9.5	20.0	21.4	2,799.9	2,858.2	.7
Missouri Pacific	57.8	34.5			92.3	126.3	3,580.0	14.7			3,594.7	3,609.3	3,687.0	3,735.6	3,741.2	3,806.2	98.1
St. Louis, Iron Mountain & Southern	113.8	13.2			127.0	140.3	2,638.2	169.4			2,807.6	2,977.0	2,934.6	3,117.3	3,096.0	3,290.5	94.7
Mobile & Ohio		4.7			4.7	9.4	51.9				51.9	51.9	56.6	61.3	822.3	827.0	6.9
Monongahela	.5				.5	.5							.5	.5	66.7	66.7	.7
Munising, Marquette & Southeastern							3.7				3.7	3.7	3.7	3.7	123.8	123.8	3.0
Nashville, Chattanooga & St. Louis							109.1	11.8			120.9	132.7	120.9	132.7	1,230.1	1,241.9	10.7
Newburgh & South Shore							.1	5.2			5.3	10.5	5.3	10.5	Freight Line.		
New York & Long Branch		38.0			38.0	76.0							38.0	76.0	38.0	76.0	100.0
New York Central Lines:																	
Boston & Albany		129.4	54.1	23.6	207.1	515.5		1.4			1.4	2.8	208.5	518.3	356.8	669.1	77.5
Chicago, Indiana & Southern		5.0			5.0	10.0	144.1	59.1			203.2	262.3	208.2	272.3	303.0	307.1	74.2
Cleveland, Cincinnati, Chicago & St. Louis	2.3	52.8			55.1	107.9	542.6	326.2			868.8	1,195.0	923.9	1,302.9	1,953.4	2,283.2	57.1
Lake Erie & Western	9.8	9.0			18.8	27.8	853.0				853.0	853.0	871.8	880.8	832.5	841.5	100.0
Lake Shore & Michigan Southern	27.8	184.0	106.9	250.2	568.9	1,717.3	1,024.2	64.0			1,088.2	1,152.2	1,657.1	2,869.5	1,567.2	2,767.1	99.8
Dunkirk, Allegheny Valley & Pittsburgh							90.5				90.5	90.5	90.5	90.5	90.5	90.5	100.0
Lake Erie & Pittsburgh							27.8				27.8	27.8	27.8	27.8	Freight Line.		
Michigan Central [3]		271.9			271.9	543.8	905.8	15.9			921.7	937.7	1,193.6	1,481.5	1,203.6	1,481.5	100.0
New York Central & Hudson River	1.9	555.9	8.2	111.8	677.8	1,595.2	1,530.1	747.4	15.4		2,352.9	3,131.2	3,030.7	4,726.4	3,059.6	4,786.3	98.7
Peoria & Eastern							84.0	1.7			85.7	87.4	85.7	87.4	337.9	340.3	25.7
Pittsburgh & Lake Erie		106.4	1.6	49.3	157.3	414.8	2.7				2.7	2.7	160.0	417.5	166.2	426.8	97.8
New York, Chicago & St. Louis	15.4				15.4	15.4							15.4	15.4	523.0	523.0	2.9
New York, New Haven & Hartford	1.6	300.5		15.8	317.9	684.2	131.9	192.8		73.7	398.4	812.3	716.3	1,496.5	2,187.5	3,120.4	47.9
New York, Ontario & Western	38.0	150.1			188.1	294.1							188.1	294.1	512.2	664.4	44.3
New York, Philadelphia & Norfolk		8.8			8.8	17.6	36.0	47.6			83.6	131.2	92.4	148.8	112 0	168.4	88.3
Cape Charles							9.4				9.4	9.4	9.4	9.4	9.5	9.5	99.2
Norfolk & Western	101.0	415.9			516.9	932.8	1,067.8				1,067.8	1,067.8	1,584.7	2,000.6	1,699.4	2,115.3	93.2
Northern Pacific	101.5	377.1			478.6	855.7	675.7	122.7			798.4	921.3	1,277.0	1,777.0	5,424.0	6,017.6	23.5
Northwestern Pacific	13.4	12.7			26 1	38.8							26.1	38.8	383 2	395 9	9.8
Pennsylvania	.9	85.5	6.1	247.2	339.7	1,202.3	2,064.4	633.6	27.7	146.2	2,871.9	4,011.3	3,211.6	5,213.6	3,211 6	5,213.6	100 0
Grand Rapids & Indiana							138.9	2.2			141.1	143.3	141.1	143.3	532.5	545.1	26.3
Northern Central			1.5		1.5	3.0	292.6	121.2		18.8	432.6	610.2	434.1	613.2	434.1	613.2	100.0
Pennsylvania Co.		453.5	21.5	52.7	527.7	1,182.3	576.5	185.9		10.6	773.0	990.7	1,300.7	2,173.0	1,652 6	2,346.0	85.4
Philadelphia, Baltimore & Washington		57.1	12.4	33.0	102.5	283.4	427.9	105.6		8.2	541.7	671.9	644.2	955.3	644.2	955.3	100.0
Pittsburgh, Cincinnati, Chicago & St. Louis		10.2		3.5	13.7	34.4	478.3	529.1	59.8	34.9	1,102.1	1,855.5	1,115.8	1,889.9	1,415.6	2,190.9	86.3
West Jersey & Sea Shore	88.8	6.3			95.1	196.5	185.5	35.5			221.0	256.5	316.1	453.0	316.1	453.3	100.0
Vandalia							300.7	61.1			361.8	423.0	361.8	423.0	797.1	868.4	48.7
Peoria & Pekin Union		.8			.8	1.6		6.0			6.0	12.0	6.8	13.6	15.2	24.2	55.7
Pere Marquette	9.3				9.3	9.3	26.6				26.6	26.6	35.9	35.9	1,628.9	1,687.4	21.2
Philadelphia & Reading	16.4	326.5	33.3	29.5	405.7	887.3	133.1	87.0			220.1	307.1	625.8	1,194.4	870.0	1,470.0	81.3
Atlantic City		86.8			86.8	173.6	35.9				35.9	35.9	122.7	209.5	164.0	251.9	83.2
Gettysburg & Harrisburg							24.2				24.2	24.2	24.2	24.2	31.0	31.0	78.1
Northeast Pennsylvania	2.8	2.0			4.8	6.8	1.6				1.6	1.6	6.4	8.4	25.6	27.6	28.4
Perkiomen							38.2				38.2	38.2	38.2	38.2	38.2	38.2	100.0
Philadelphia, Newton & New York	3.8	1.7	1.6		7.1	12.0							7.1	12.0	21.7	26.6	45.1
Reading & Columbia							34.9				34.9	34.9	34.9	34.9	53.3	53.3	65.4
Quincy, Omaha & Kansas City and Iowa & St. Louis							307.8				307.8	307.8	307.8	307.8	307.8	307.8	100.0
Queen & Crescent Route:																	
Alabama & Vicksburg	16.0				16.0	16.0							16.0	16.0	139.3	139.3	11.5
Alabama Great Southern	108.1	.4			108.5	108.9	74.1				74.1	74.1	182.6	183.0	290.5	297.7	61.4
Cincinnati, New Orleans & Texas Pacific	252.1	82.6			334.7	417.3	.7				.7	.7	335.4	418.0	335.4	418.0	100.0
New Orleans & Northeastern	93.0	15.5			108.5	124.0							108.5	124.0	195.6	211.1	58.7
Richmond, Fredericksburg & Potomac							9.0	78.7			87.7	166.4	87.7	166.4	87.7	166.4	100.0
St. Joseph & Grand Island							3				3	3	3	3	251.6	251.6	.1
St. Louis & San Francisco	726.5	34.1			760.6	794.7	108.3				108.3	108.3	868.9	903.0	5,255.0	5,335.8	16.9
Beaumont, Sour Lake & Western							84.3				84.3	84.3	84.3	84.3	118.3	118.3	71.3
New Orleans, Texas & Mexico							157.6				157.6	157.6	157.6	157.6	275.5	275.5	56.1
Orange & Northwestern							61.6				61.6	61.6	61.6	61.6	61.6	61.6	100.0
St. Louis, Brownsville & Mexico							451.1				451.1	451.1	451.1	451.1	497.0	497.0	90.8
St. Louis Merchants' Bridge Terminal		5.9			5.9	11.8		1.1			1.1	2.2	7.0	14.0	9.9	19.8	7.7
St. Louis Southwestern	.4				4	.4							.4	.4	650.2	652.6	
San Francisco, Oakland & San Jose Consolidated		3.9			3.9	7.8							3.9	7.8	21.8	36.0	21.4
San Pedro, Los Angeles & Salt Lake	3.7				3.7	3.7							3.7	3.7	1,134.6	1,134.6	.3
Seaboard Air Line							211.1				211.1	211.1	211.1	211.1	2,820.3	2,820.3	7.4
Southern		14.7			14.7	29.4	1,582.3	331.5			1,913.8	2,225.3	1,926.5	2,254.7	6,636.3	7,007.8	32.2
Virginia & Southwestern							2.2				2.2	2.2	2.2	2.2	225.4	225.4	1.0
Southern Illinois & Missouri Bridge		4.6			4.6	9.2							4.6	9.2	4.6	9.2	100.0

[1] (Hudson & Manhattan.) Light signals, not shown in Table No. 2.
[2] (Louisville & Nashville.) 22.3 miles of road in manual block territory covered by automatic signals not shown in these tables.
[3] (Michigan Central.) 244.8 miles double track in Canada equipped with automatic signals not shown in these tables.

AGGREGATE LENGTH OF LINES AND PARTS OF LINES ON WHICH THE BLOCK SYSTEM WAS IN USE ON JAN. 1, 1913—Continued.

Names of railroads.	Automatic block signals.						Nonautomatic block signals						Total automatic and nonautomatic.		Total passenger lines operated.		Percentage block signaled, miles of track.
	Single track.	Double track.	Three track.	Four track.	Total.		Single track.	Double track.	Three track.	Four track.	Total.						
					Miles of road.	Miles of track.					Miles of road.	Miles of track.	Miles of road.	Miles of track.	Miles of road.	Miles of track.	
Southern Pacific, Atlantic system:																	
Galveston, Harrisburg & San Antonio	279.1				279.1	279.1							279.1	279.1	1,270.3	1,274.8	21.9
Louisiana Western	103.6				103.6	103.6							103.6	103.6	140.5	140.5	73.8
Morgan's Louisiana & Texas	95.3				95.3	95.3							95.3	95.3	292.9	332.1	28.6
Texas & New Orleans	109.8				109.8	109.8							109.8	109.8	438.4	441.8	24.9
Southern Pacific, Pacific system [1]	2,227.3	254.7	3.1	3.5	2,488.6	2,737.3	37.3	28.7			66.0	94.7	2,554.6	2,832.0	6,615.8	6,958.4	41.2
Spokane & Inland Empire	.3				.3	.3							.3	.3	168.3	187.3	.1
Spokane, Portland & Seattle	5	6.8			7.3	14.1							7.3	14.1	505.6	515.6	2.7
Staten Island Rapid Transit		10.3		.6	10.9	23.0							10.9	23.0	10.9	23.0	100.0
Staten Island		10.2			10.2	20.4	2.5				2.5	2.5	12.7	22.9	12.7	22.9	100.0
Syracuse, Lake Shore & Northern	17.3	6.5			23.8	30.3							23.8	30.3	37.1	56.1	54.0
Terminal R. R. Assn of St. Louis	6.0				6.0	12.0		1.1			1.1	2.2	7.1	14.2	12.7	25.4	56.0
Texas & Pacific	1.0				1.0	1.0							1.0	1.0	1,885.0	1,885.0	
Tidewater Power Co							6.2				6.2	6.2	6.2	6.2	11.3	15.7	39.5
Toledo, Peoria & Western							.3				.3	.3	.3	.3	220.0	220.0	.1
Toledo, St. Louis & Western							188.1				188.1	188.1	188.1	188.1	451.0	451.0	41.7
Ulster & Delaware	24.4				24.4	24.4							24.4	24.4	126.3	126.3	19.8
Union		.6			.6	1.2	1.4				1.4	1.4	2.0	2.6	7.4	14.8	17.5
Union Pacific	740.3	727.7		1.7	1,469.7	2,198.5	10.9				10.9	10.9	1,480.6	2,209.4	3,541.3	4,312.2	51.2
Oregon-Washington R. R. & Navigation Co	416.8	19.2			436.0	455.2	1.3				1.3	1.3	437.3	456.5	1,070.7	1,094.1	42.5
Oregon Short Line	518.7	57.2			575.9	633 1							575.9	633.1	1,545.4	1,604.6	39.4
Virginia & Kentucky							.6				.6	.6	.6	.6	4.8	4.8	12.5
Virginian							17.6				17.6	17.6	17.6	17.6	460.0	460.0	3.8
Wabash	39.2	19.7			58.9	78.6	1,648.9	200.9			1,849.8	2,050.7	1,908.7	2,129.3	1,987.9	2,188.8	97.2
Wabash Pittsburgh Terminal		4.1			4.1	8.2							4.1	8.2	63.3	67.4	12.2
Washington Southern		4.1		1.5	5.6	14.2		26.6			26.6	53.2	32.2	67.4	32.2	67.4	100.0
Washington, Baltimore & Annapolis	13.8				13.8	13.8							13.8	13.8	52.2	84.4	16.3
Washington Terminal		1.1		1.0	2.1	20.4							2.1	20.4	2.1	20.4	100.0
Washington Water Power Co	22.5				22.5	22.5							22.5	22.5	22.5	22.5	100.0
Western Pacific	11.2				11.2	11.2							11.2	11.2	11.2	11.2	100.0
Total	10,128.1	10,728.7	368.0	994.0	22,218.8	36,934.3	52,833.6	8,366.9	230.6	299.9	61,731.0	71,468.7	83,949.8	108,403.0	183,460.8	209,902.2	

[1] Southern Pacific—Pacific system: 35.4 miles single track protected by both the electric train staff and automatic block signals, shown only under automatic signals in this table. On 28.7 miles of double track road one track is equipped with automatic signals and the other with the electric train staff. This mileage is shown as double track in the columns for both automatic and nonautomatic signals.

The Maintenance of Way Department

Supervision of Extra Gangs.

THERE seems to be a quite general opinion that an extra gang doing surfacing, putting in ties, etc., should be placed, successively, in charge of those section foremen whose sections need attention. There seem to be a good many reasons why this system would not be successful. It is a known fact, in general, with a new foreman or a new gang of laborers, less work is accomplished. This presupposes that the new foreman or the new gang of laborers is of about the same class. Of course it is true that occasionally a good gang of new men will replace an old gang of poor men and accomplish more from the start, but such cases are rare.

It takes considerable time to get a new gang organized and the men broken in on the several kinds of work to which they are adapted. After all this work has been done, and after the foreman is just beginning to get acquainted with the personal characteristics of each laborer, is it profitable to turn the gang over to a new foreman?

From the standpoint of the foremen, the loss in efficiency is liable to be just as great. The foreman gradually acquires speed and precision in his own work, and probably attains his greatest efficiency only after several weeks. For instance, in raising track, a man's eye will not be able to follow the jacks and use the spot board and blocks quickly and with least knocking down of the joints, until he has been in the work for a number of days. The same holds true in lining track. Lack of practice causes the foreman to lose a portion of his rapidity and skill. No two jack men tamp with the same speed, and it takes a foreman some time to get so he can estimate just how high to raise the track so the tamping of his particular pair of jack tampers will hold the track just at the spot. After a foreman's eye again gets in training, after he just becomes acquainted with the capacities and vagaries of the individual men, will it be profitable to send him back to his own section and break in another foreman?

We believe that all extra gangs should be handled by section foremen, but they should be appointed extra gang foremen, and each one should retain his gang until it is laid off. The right kind of section foreman realizes the importance of good work, and is not likely to slight work unless forced to do so. If it were possible to induce railways to employ permanent floating gangs, decreasing the number of men somewhat, and the number of hours considerably in the winter, a more satisfactory organization would result; and in that case a thoroughly reliable foreman should be the one promoted to foreman of the extra gang; and then promotions should be made according to ability in the following order: laborer, assistant foreman, section foreman, assistant roadmaster, and roadmaster. This system would tend to develop men of wide experience in handling laborers of all classes, for roadmasters.

The effect of changing foremen is to demoralize the gang. Those who have handled gangs of foreigners turned over to them from another foreman, will realize that this is true. If the section foreman has not handled large gangs, the result is disastrous. The men quickly realize his inexperience and do practically no work. Extra gang men realize the difficulty

of getting work out of a gang turned over from another foreman, and, in general, they always expect that practically a new gang must be obtained before they can get satisfactory work done.

ENTERTAINMENT PROGRAM TO BE TENDERED THE ROADMASTERS AND MAINTENANCE OF WAY ASSOCIATION.

The Track Supply Association has arranged the following program for the entertainment of the Roadmasters and the Ladies' Auxiliary, at the annual convention to be held at Chicago, Sept. 9, 10, 11, 12.

Program of the Track Supply Association.

Wednesday, September 10th.

Automobile ride for ladies, through the parks and boulevards of Chicago.

Boat ride on steamer United States, leaving Clark St. bridge at 6:00 p. m. Dinner will be served. Music for dancing. For roadmasters, wives and daughters, and members of the Track Supply Association.

Thursday, September 11th.

Attend baseball game, 3:30 p. m. Cubs vs. Brooklyn. For members Roadmasters' and Maintenance of Way Association, wives and guests, also members of the Track Supply Association.

Evening Entertainment, September 11th.

Theater party for all the ladies.

The second annual banquet, given by the Track Supply Association in honor of the members and guests of the Roadmasters' and Maintenance of Way Association.

The following gentlemen have been invited and will address the guests:

Mr. H. R. Safford, chf. engr., Grand Trunk Ry.
Mr. W. L. Parks, vice pres., Illinois Central R. R.
Mr. W. A. Garrett, vice pres., C. G. W. R. R.
Mr. Paul Hamilton, engr, track and rdy., C. C. C. & St. L. Ry.
Mr. Jas. Burke, supt. rdy., b. & b., Erie R. R.
Mr. C. E. Lindsay, div. engr., N. Y. C. & H. R. R. R.
Dr. J. S. LeSeur, N. Y. C. & H. R. R. R.
H. Scatchard, gen. stkpr., N. & W. Ry.

Goldsmith Orchestra and Oxford Quartette will furnish entertainment during the banquet.

RAILWAY MOTOR CARS.

Operation and Upkeep.

J. R. Edwards, General Inspector of Motor Cars.

Since the railroad motor car has become so important a factor in maintaining right-of-way, the question of how to derive the highest efficiency from these cars arises simultaneously.

Car of Cars.

There is one point that cannot be emphasized too strongly, viz.: *Keep the cars clean.* This may not appear of vital importance, but, nevertheless, it is one of the most important points in maintaining efficiency in this service.

Spend a little time every day cleaning off the grease and dirt, and it should be well done at least once or twice a week, depending on the condition of the car—once a week at the very least is necessary.

A daily inspection of the car is also most important. This means tightening any screws or nuts that may have worked loose during the day's run. This can be done at night or in the morning, but it should be done daily.

It is very seldom necessary to take a car apart, but in such case it is essential to put a competent man on the job. As a rule, section foremen are not trained for this sort of work, and when they attempt to repair a car frequently do more damage than good.

When a car requires repairing, aside from the engine, don't run the car—repair it, and avoid accidents, perhaps possible loss of life.

In filling the gasoline tank, it is advisable to strain the gasoline through chamois skin; this draws out any water impurities that may be in the fuel. If the gasoline feed tube leaks do not run the car, because the chances are it will catch fire.

Always cover the car when not in use, giving it as much protection from the elements as possible.

Be sure the car is properly oiled—but don't overdo it. Keep oil and grease away from insulated wires; in time the oil will soak through and ruin the insulation.

When testing a spark plug, do not hold it more than one-quarter (¼) of an inch from the cylinder, otherwise the coil will be injured, and possibly burned out. Spark plugs seldom wear out; as a rule, all that is needed is a thorough cleaning. When screwing in spark plugs, it is not necessary to screw them in excessively tight; if this is done, they will expand so much that it will be almost impossible to get them out again.

Sometimes in cold weather dry cells will freeze up. This does not mean that they are run down; thaw them out and usually they will be ready for use.

When leaving the car, throw off the battery switch and close the gasoline valve.

If the car is water-cooled, drain the water from the radiator and cylinder in freezing weather; this prevents the cylinder from cracking by reason of a frozen cooling system.

Operation.

Before starting a car examine the gasoline tank and see that there is sufficient fuel to run it to destination. When the engine starts, advance the timer lever slowly. Always carry timer lever ahead of throttle lever when running; this not only saves gasoline, but enables you to get more power out of the car. See that grease cups are screwed up tight, and that the car is sufficiently oiled before starting.

A car should not be run faster than twenty miles per hour. When running a car behind a train, don't try to keep up with the train—run at least 1,000 feet in the rear.

Don't try to make grandstand stops—the brake may fail. Test the brakes before starting. When approaching road crossing, run slow, with engine cut out, and always at such speed that the car may be stopped before running on the crossing in cases of emergency. It is advisable to have bells on the cars to notify crossing watchmen of approach. When running at night, have a white light on the head end and red on the rear end of car.

When being overtaken by a following train, get the car off the track at once. Don't see how long you can keep the lead—the engine may fail and accidents result.

These discursive remarks are designed to give some general information not usually furnished by manufacturers. The writer will reply to any inquiries on the subject, addressed care of this magazine.

DERAILMENTS.*

By J. D. Shannon, Superintendent of Maintenance.

It is very advisable that every effort be made to discover the cause of a derailment, so that steps may be taken to correct any defects and avoid a recurrence of the accident. It is sometimes difficult to assign the cause, for the evidence is sometimes destroyed as a result of the derailment. The investigation should be started immediately, and every effort put forth to obtain a reasonable solution. Notes must be taken as quickly as possible of marks on rails, ties or ballast, position and condition of derailed equipment, as other conflicting and confusing marks will undoubtedly be made in clearing the line.

Derailments may be caused by (1) defects of track; (2) defects of equipment; (3) defects of operation; (4) a combination of defects.

1. *Defects of track.* These may be due to (a) incorrect gauge; (b) sags and humps; (c) poor alignment; (d) improper

*Abstracted, from the South African Railways Magazine.

or non-uniform curve elevation; (e) worn curve rails; (f) broken rail.

Widening of gauge on curves may result in letting the inside wheel drop off the rail, inside the track. The wheel may run in this position for some distance. The inner rail will sometimes spring back to place, and upon cursory examination the track may appear to be O. K. Gauge which is wide but not wide enough to cause derailments will cause rough riding on tangents for fast trains.

When running on a curve, there is a tendency for the wheel to climb the outside rails, the weight on the wheel being the force which resists this tendency. Short sags decrease momentarily the weight on a wheel. Sometimes this reduction is sufficient to allow the wheel to climb the rail and get off the track. When only one wheel is in a sag or, for instance, on a low joint, practically the whole load would be carried on two diagonally opposite wheels. The springs tend to counteract the effect of sags, but the latter are dangerous on a curve under high speed traffic.

Sags first on one side and then on the opposite side of track are still more dangerous, and are likely to cause a rolling which still further decreases the load on wheels. When climbing a short hump in track there is a tendency for the wheels to continue on above the rail at the top of the hump. If the rolling motion of a car is increased in each successive sag there is considerable danger of derailment; that is, if the period of rolling or oscillation of the car corresponds to the distance between sags. The period of rolling or oscillation is different with different cars and speeds, and a derailment is liable to happen on track over which many trains of the same type cars have passed at high speed. A sag of a half inch will be compensated for by the springs. Deeper sags, and sags diagonally opposite, are dangerous.

Track must be quite badly out of alignment to cause derailments. Sun kinks, however, will always be large enough to cause derailments at any considerable speed. When investigating a derailment, therefore, the possibility that the track kinked should not be overlooked.

Elevation on curves is dangerous if irregular, or if the elevation is brought up too quickly. Excessive elevation is liable to cause slow moving wheels to climb the lower rail. Insufficient elevation is dangerous at high but not at low speeds.

Worn rails on curves are sometimes blamed for derailments, but it is doubtful of they are responsible for them.

Broken rails may frequently cause a derailment, but it is usually difficult to tell whether the broken rail was the cause or effect of the derailment.

2. *Defects of Equipment.* These may be as follows: (a) Lightening of load on wheel by weak spring, etc.; (b) broken or loose wheel, or broken axle; (c) worn tires (in connection with track defects); (d) difference in height of couplings; (e) binding of truck and main car frame, preventing truck from turning.

Weak springs, defects in fittings or adjustment of the spring hangers may cause a reduction of load on a wheel, and thus introduce danger of derailment. Binding of the axle box in a warped truck frame produces a similar effect. The weak spring or other defect may be at the diagonally opposite wheel. The best way to detect such a defect, if not obvious, is to measure the load on each wheel.

The results from the other causes—b, c, d and e—are obvious.

3. *Defects of Operation.* These may be: (a) Excessive speed; (b) sudden application of brakes; (c) unequal distribution of load in car; (d) moving switch points under train, or failing to close them properly; (f) propelling a heavy train around a sharp curve.

With passenger trains on sharp curves, overturning is more liable to occur than wheels climbing the rail. Freight trains are more likely to climb the rail. Usually the derailed wheels go to the outside, but occasionally they go to the inside on a poorly lined curve. The latter is probably caused by the trucks assuming an angle for a sharp curve, and when the curve slackens suddenly, the wheels, being headed toward the low side, may climb the low rail, since practically all the weight has been thrown on the outside wheels when hitting the curve. The truck would be resting on the swivel blocks on the high side, and would not turn easily. Such an accident could only occur with heavy freight train rounding a curve at excessive speed. A derailment on the inside of a curve might be caused by ballast washing out on that side, or by a part of the truck breaking and dropping down in a position to force the car over the inside rail.

It is doubtful if sudden application of the brakes can, unaided, cause a derailment. An application of air on all the cars will probably never cause one car to slack up enough more than another to cause it to be forced over the rail. Even with trains not fully equipped with brakes, the writer has never seen a derailment properly traceable to this cause.

Unequal distribution of load causes reduction in the load on the wheel. Derailments caused by unclosed points need no explanation.

An engine with a long wheel base, backing up at high speed with a train around a curve, is subjected to increased flange pressure, which could easily be sufficient to cause derailment.

4. *Combination of Defects.* Many wrecks are undoubtedly due to a combination of defects. High speed and rough track are often causes of derailments. Unequal distribution of load and a weak spring may both be combined with the other two. This illustrates the fact that there should be close co-operation between railway men of all departments.

RAIL RAVELINGS.

Dear Son:

Your experience with lack of organization at the washout of which you wrote has been and still is being paralleled myriads of times on the railways of the country. For instance; a roadmaster or some other official orders a number of section crews to some point to lay a siding, relay steel, or fix up a piece of track that from some cause has "gone to pieces" and for which no extra gang is available. And failing to be on the job himself or to notify all concerned that a certain foreman will be in charge creates a condition where each foreman is apt to work independently of the others, for, as you have had abundant cause to know, trackmen as a rule are intensely jealous of their authority and of each other, and quickly resent what they call interference by another foreman. A bunch of men assembled under the above conditions are about as effective and will accomplish about as much as would a regiment of troops, broken up into small detachments or squads, each in charge of a petty officer with no commanding officer and no general orders for concerted action, would be in repulsing the attack of an enemy. How many times in cases of the kind have you seen the foremen get together and have a friendly chat, the laborers taking their cue from them and visiting with each other, tamping listlessly with only one hand on the shovel, the action being simply automatic from force of habit. The last thing in the minds of any of them is the work in hand, their interest for the time, being centered entirely on something foreign to what it should be, and all this for the want of a head to organize, plan, direct and execute.

This is not only true of track forces but similar conditions arise in other departments as well. A case came under my personal notice recently in the train service at a station where there were only two side tracks, one of which was filled to its full capacity, where four trains met. There was just one way to handle these train without serious delay. One conductor saw this and proposed it to an older conductor. He would not listen to it, in fact, could not see it that way at all, and the result was a "bucking match" with serious delay to all concerned. The reason was, "No biga boss," as an Italian would say. Perhaps in the above case it is not practical or possible

to have some one in supreme command on the ground, but this incident shows clearly the result of lack of authority vested in some one person.

At one time I was stationed where a new yard was under process of construction. My duties prevented me from taking active charge as had been planned, and the supervision was left largely to a civil engineer, a good man who afterwards learned his lesson, made good and now holds a responsible and lucrative position with one of the principal railways of the West. But at that time he was not an organizer. I was called into the superintendent's office one day during the early stages of the work. The civil engineer was there and evidently had received a "calling." The superintendent started a line of talk to me something like this: "I want you to go to the new yard tomorrow and see if you can't get things started. We have men and material on the ground and all it needs is a little intelligent supervision to get an organization perfected to make the work go." Soon after this the civil engineer lost out, but later on was reinstated, and as I said before, made good.

You spoke of the old track foreman who rebelled but finally did the work as you directed. He was not slow to see the result of organization and concerted action. I have met him a number of times since and he always asks about you and speaks highly of you and the way you conducted the work at the time when you was "only a kid." There are a great many in authority who have to be "shown" to make them realize the value of organization, even in small affairs. But enough of this. For, as you say, your pet hobby is "organization" and if I keep ringing up on it you are likely to ride it to death.

DAD.

PRACTICAL AND IMPRACTICAL PHASES OF TRACK PIECE WORK.

J. J. Morgan.

The question now openly confronts us: "What is the best method of granting remuneration for the services of track labor?" Generally speaking, railroad companies have concluded that the hourly wage basis is the most satisfactory and profitable, both to themselves and their employes. But they did not decide this important question offhand. It required considerable deliberation before reaching any definite conclusion in this regard, for much depended upon their decision. After many years of continuous application the hourly wage basis has decidedly proven itself to be the most advantageous process of paying track forces for services rendered. However, there exist a few more or less ingenious persons who are endeavoring to stimulate other methods (piece work systems in particular) to replace the one now in use at the present time; but their efforts for the most part are met with dissension. To conceive a more lucrative system than that of the hourly wage scale is a very difficult proposition.

Two Sides to the Story.

It is a common saying that there are two sides to every story, and the piece work "story" is by no means an exception. Experience indicates that it is possible to operate piece work methods in large extra or construction gangs, where only the one kind of work is performed; such as laying rail, ballasting, putting in ties, etc. These particular classes of work admit of a substantial paying basis wherein quantity equals cash. But the quality of the work should be given the closest attention wherever such a system is being used, as there is a tendency on the part of the men to be careless in this respect when a question of money is concerned.

The Other Side.

On the other hand, however profitable a piece-work system may appear when applied to extra gangs, its doom seems to be at hand when attempted in section gang work. Reasons for this are, indeed, numerous. One fact alone would seem to be sufficient to discourage any movement towards the establishment of anything contrary to the hourly wage scale as a source of remuneration for section forces, viz., the varying nature of the work itself. This needs no explanation whatever, but in order to extinguish any existing doubt on the subject let us glance over the section foreman's report of work done for one day. We find that the time of the gang is divided up among many different classes of work. First, we find him replacing a few ties which were damaged by a recent derailment; next he is raising a low spot in track; again he is removing a defective rail, and he winds up the day in cleaning up station grounds and driveways. This, we will say, constituted the work of one section gang for one day. By referring to the previous reports of this gang we find that during the period of one month the time of the gang has been devoted to numerous kinds of work, ranging in importance and longevity, big jobs and little jobs, which were, nevertheless, absolutely necessary and essential. How could a piece-work system be applied to this routine? "Well," you may reply, "if the work was systematized correctly a piece-work section gang would be easily forthcoming."

This might be a good remedy for the situation, but it is almost an impossibility. Starting out in the morning, the foreman could have his program laid out for the entire day, but when 6 p. m. comes around compare his "program" with the actual work accomplished—quite a difference. He intended to trim up a certain amount of ballast on his section that day; as the day progressed other more important items were brought to his attention and it was necessary for him to depart from his proposed order of procedure, resulting in the program not being carried out. The "little things" count up in section work as in any other line, and they cannot be neglected or put aside in order that some new-fangled idea may be put through. Even if it were at all possible to handle section labor on a piece-work scale, a great volume of extra clerical work would be incurred. Its operation would necessitate additional clerical forces to distribute, classify and consolidate the various kinds of work performed as to quantity, rate, etc., and the amount due each and every man would have to be ascertained at the end of the paying periods without causing any delays to payrolls. The cost of all this extra help required to properly handle such a system would go a great ways towards offsetting its profitableness. In the end, no doubt, it would result in one continuous round of dissatisfaction, trouble and disagreement. Weather and climatic conditions would also interfere with the wages of the men to a considerable degree; but if they did not receive an amount at least equivalent to that offered in other branches of industry, they would naturally seek employment where their services would be better compensated. Thus the unfeasibility of section piece work is clearly perceivable.

Service vs. Capability.

Another point of controversy which would arise if a piece-work system was inaugurated would be the "Service vs. Capability Problem." In going among the different section gangs we notice that there are mingled both young and old men, comparatively speaking. With a piece-work system the young men would naturally receive the greater benefit, in that they possess more strength and vigor than do the older laborers, and could therefore turn out more work. If the system was based on individual results their pay envelopes would amount to considerably more than those of the older men, which would not be favorable to the latter; and if the system was based on the work accomplished by the entire gang, each man being given an equal average, then there would result dissatisfaction from the younger set, for they would argue that they did more work than the others and were therefore entitled to be reimbursed accordingly. They would not be content until the older men were dismissed from the gang in order that their efforts be satisfactorily rewarded. However, human nature steps in at this juncture and we are forced to consider, in the case of men who have exerted their best efforts during their younger days and

who, although they have not passed the period of their usefulness, have not the alacrity and quickness of youth—is it consistent that they be released from the service in order that the younger fellows may profit thereby? In most cases the railroads retain their services (as long as their reliability holds out) under the present system, reasoning that men who have served long and faithfully and still continue to serve to the best of their ability, at least deserve a fair deal when it comes to a question of this nature.

Averages and Supervision.

Apparently there cannot be a very marked improvement over the present system of paying section forces. It gives satisfaction now and always shall give satisfaction as long as the wage scale is right. The men are now paid for the time they work. If it is necessary to work longer than the prescribed time, they are paid for the overtime they expend. The amount of work usually performed by section forces is all that is required in any locality. In fact, a maximum amount of work is accomplished for the time allotted where there is the right kind of supervision. There would be no reason whatever for any change if the gangs received the proper handling, and the work was performed according to first-class principles, not in the way that a foreman may happen to be accustomed to or prefers, but according to a standard method prescribed by those in authority—in a manner found to be the most profitable. There should be a computed average of each and every kind of work in the line of track labor, an average computed on a maximum limit of work that could be performed by any section gang under ordinary circumstances in a given length of time, the supervising officer to keep a close watch on the various gangs and see how their results compare with the averages. If they are running behind in averages, he should ascertain the reason why, see where the leak is, and remedy it so as to bring up the average. Also, if it so happens that a certain gang reaches even a higher average than the standard, the supervising official should investigate carefully and determine whether the foreman does not use some special method in doing this particular work, and if so, should find out the details of such a method; if practical, the new method should be placed in the reach of all, thereby raising the average, and it would be a good plan to make public any new method so that other roads would be benefited as well, in that it would result in a saving of labor and money.

Must Handle Labor "With Care."

Labor nowadays has to be handled with "silk gloves." In order to preserve the good will of track forces, particularly section gangs, any relations with piece work should be definitely broken, and its connection with extra or construction work keenly watched. Men old in the service should not be overlooked and cast aside—that would not be a very favorable incentive for the younger men to look forward to. With a knowledge of the average amounts of work which should be performed, coupled with correct supervision, there would be no apparent motive for changing from the hourly wage to the piece work or any other method. If any railroad companies are considering such a move, they should indeed go slowly, as there is a weighty question involved, a wrong solution of which would place organization in a very hazardous position.

PREVENTION AND REPAIR OF WASHOUTS.

D. C. Davis, Roadmaster.

My experience with washouts has been extensive and in various locations which would require different ways to prevent and to make temporary repairs so trains would not be delayed.

In the first place track should, if possible, be put high enough to prevent washouts, but there are localities where it would be an impossibility to accomplish this. Then it becomes necessary to devise some means to prevent, as much as possible, track washing out so that trains can be operated even if the water was running over the track.

To accomplish this the track should be riprapped on the lower side so that water passing over it would not start a wash, thus leaving the track bed solid, and trains could be operated safely until the water got so high that it would put out the fire in the locomotive or cause the track to float.

In order to hold down the track and keep it on the roadbed, I have had piling driven in the center of the track every 60 ft. to about the top of the ties, and had a hole bored through the top of the piling, and a hole bored in each rail opposite, and wired the rails to the piling. This would not permit the track to raise or float away and if the lower side was well riprapped, the road bed would not be much damaged and traffic could be resumed in a short time after the water had receded.

At one place we had over a mile and a half under water from two to four feet and a swift current running, but by having the lower side well riprapped, and the track anchored, we were able to have trains pass over by using an engine with a high fire box. There was only a short distance that was four ft. under water, the most being about 2 to 3 ft., and we patrolled the track with hip boots to see that there were no washed out places.

Two years ago we had the track washed out for 6 miles in spots, and some places the fill was washed at bridge approaches to a depth of 3 ft. for two or three hundred ft. Some railway men went over the washout and made a report that it would take at least two days to get trains over. I had 14 men to start out in the morning and at noon had increased the number to 20. In the meantime we got a work train and while some were throwing the track back on the dump, others were blocking up and unloading material, which was principally cinders. We pushed the loads ahead of the engine and upon the blocked track and dumped as far as safe, and then pulled back and raised any weak places. Then we went ahead again and in this way we got over all washed places and at 7 p. m. I only had two more cars to unload and the track was ready for trains. After taking supper we went out and dumped the two cars and reported that the track was ready for trains which surprised the assistant superintendent, as he had been over and concluded that it would take two days.

Last year we had 3000 ft. washed out and I reached the place at 1 p. m. and followed the same plan. At 4 p. m. I had track ready for trains and only had 12 men. At another place, later on, we had 400 ft. under water and 150 ft. washed out three feet below the ties and the current so swift we could not stand up in the water without holding to the rails.

By having one man on the lower side and another the upper, we sunk pairs of ties, one on top of the other and then placed a jack under the base of the rail and lifted the track and put a tie length-way with the track and let down and kept moving ahead, repeating the operation until we got across the wash. Then by pushing cars of cinders, center dumps, out on the blocked track and dumping enough to get above the water, we soon stopped the break and were ready to permit trains to go over in about three hours after we arrived at the place. I have track that is riprapped on the lower side where the water was over it last year to a depth of 20 inches, with a swift current running, and we never had to stop a train—only slowed them up. This track was cinder ballasted which is easily washed, and the riprap was the only thing that prevented a washout with delayed trains.

I have had washouts where we were not expecting it and were not prepared to make repairs and would have to wait until the water had receded so we could block up for trains; but we commenced the work as soon as possible and at one bridge that had washed out we commenced cribbing when the water was 6 ft. deep, by spiking four ties together with boat spikes and then building downward until we could hold the crib and in this way we had the bridge ready before the water was low enough to proceed with the track repairing.

While we can make repairs at one place in a certain way it would take other means to accomplish the same at other

places, so there cannot be any fixed rules as to how work can be best done after a washout. Only by being on the ground and knowing the situation and what you have to work with can you make the repairs, and this is one of the most important things in getting over a bad washout—be on the ground as quickly as possible.

The most important thing is to prevent the washout. If unable to do this, make such preparations as are necessary to make quick repairs after the water has gotten low enough to permit work.

A good riprap on the lower side is the best preventive that I know of and by having the track well anchored trains can be kept running unless the water gets too deep; but even then the traffic can be resumed as soon as the water is low enough for the trains to be run through, as there would not have to be any track built, except, perhaps, a few places blocked or tamped up where the ballast had worked out from under a few ties.

I have assisted in rebuilding 42 miles of track that had washed out and it cost $65,000.00 to put the track in condition for use. But the work was done in such a manner none of it has been washed out since.

THE TECHNICAL SOCIETY AS AN INFLUENCE IN EDUCATION.*

By Albert Reichmann, President, Western Society of Engineers.

Engineering is not an exact science. Therefore to be proficient an engineer must have in addition to his theoretical training the requisite amount of practice and experience. The training that an engineer receives at a university is so broad that to a limited degree it enables him to commence the practice of almost any branch of his profession. But so very broad is the field of engineering and so keen the competition in every line that in order to excel an engineer must choose a comparatively narrow field of activity in order that he may become thoroughly proficient therein. The progress of the world is so rapid, the field of human achievement so complicated that a man must be unusually able to anywhere near keep step with the onward march of events.

An engineer, therefore, must specialize along certain specific lines if he hopes to attain success; he must not only give the best that is in him to his immediate calling, but he must also study and observe the relation of his work to that of the other lines which have a bearing thereon. For instance, the expert in the construction and maintenance of railroad track should not only master the subject of track construction, but he must also watch the developments that are taking place in the motors and the rolling stock which pass over the road. We have a notable example of this in connection with the development of the steam engine. After it was generally believed that this machine had attained its maximum efficiency it was found that it was not suitable for generating electricity, and as a result the steam turbine was evolved.

It is very evident, therefore, that an engineer, if he be successful, cannot be a recluse. He must associate with his fellow engineers. Now he can best secure such association through the technical societies. The meeting of engineers under conditions where all are on a common footing fosters a spirit of kindly coöperation and helpfulness which binds them together and makes each of greater usefulness to the other.

As in the legal profession, the decisions of the judges are entered and published, thus forming a basis of precedent for future use, so also it is desirable that records of important engineering work should be published in order that we may benefit by the experience of others. Many of the larger engineering undertakings are the result of the coöperation of several engineers who are proficient in their respective fields. It is, of course, customary to have a chief engineer at the head of any important enterprise; nevertheless, the work which he supervises is usually the product not of himself alone but of those also who are associated with him. It frequently happens that on large undertakings experts in various lines of the work are employed, and the duty of the chief then consists in determining the general scope of the work, the special features being developed by these experts in their respective line. For instance: The building of a large steel plant requires expert metallurgical engineers, electrical engineers, mechanical engineers and structural engineers. It is manifest then that as the work becomes of great magnitude it is most important that accurate records of the same should be made available. These records can best be promulgated through the proceedings of technical societies.

The literature published by the technical societies keeps the student abreast of the times, familiarizing him with the large problems with which engineers have to cope, and putting him in touch with the opinions and investigations of professional engineers who have devoted their lives to the development and progress in some special branch of engineering. The articles carefully read will be of great value to the student in solving his own problems in after life.

Technical societies also afford the younger engineers the opportunity of securing the experience of older engineers, resulting from the fact that they are permitted to participate on an even footing in the discussion of the papers presented.

The older engineers should and generally do take great interest in the work of the student engineers, and the latter may be greatly profited thereby.

The influence of the technical society and its value to the professional engineer is probably even greater than to the student. The practicing engineer is no longer under the guidance of professors and instructors, and his opinions and development of ideas must be largely molded by those with whom he associates.

To be well educated involves not merely the mastery of knowledge, statistics and current events, but education should also embody the broadmindedness which can see the justice and good sense of the other fellow's opinions and beliefs. A comprehensive judgment of various views and solutions is only possible through the assimilation of ideas and associations such as an engineering society offers.

In the technical societies the various steps of mechanical development are depicted both from the practical and theoretical standpoint. They afford the engineer an opportunity to supplement his own knowledge by the experience of his fellow engineers. They afford him the opportunity to present to the world what he himself has accomplished and to receive criticisms and suggestions from his fellow men, and, resulting from the discussion of the various subjects which are presented, the engineer learns to appreciate the benefits of coöperation, by means of which both the giver and receiver are greatly benefited.

*An address delivered at the Railway Conference held in connection with the dedication of the Transportation Building, the Locomotive Laboratory and the Mining Laboratory at the University of Illinois, May 8 and 9, 1913.

The New York Central will allow $40,000 toward the cost of the construction of the proposed new overhead crossing in Bridge street, Amsterdam, N. Y., the same to be part of the new river bridge across the Mohawk river.

The New York Central & Hudson River has acquired two squares of property west of its Kent street yards at Rochester, N. Y., and, according to report, has plans in preparation for improvements to its freight terminals.

The New York & Long Branch has awarded a contract for a bridge to be constructed at Red Bank, N. J., requiring 1,500 tons of structural steel to the American Bridge Co.

The Southern Pacific, it is said, has acquired title to 2½ blocks of real estate in Galveston, Tex., to provide for future terminal extension.

The Philadelphia & Reading will build a steel bridge in place of the old wooden trestle bridge at Morysville, and also at Wren's on the Colebrookdale branch.

MAINTENANCE BY THE PIECE.

J. D. McRae.

The suggestion that we adopt the "European plan," in southern European garb, for maintenance work, brings to mind an expression of disgust heard years ago, but which has always stuck, "The bookkeeping had become more important than the business." If conditions in the most important branch of railroading, (and the words "most important" are used advisedly), are almost or quite unbearable, is it not a confession of extremely poor management somewhere? The question is, who is to blame?

In this branch of work the unions have not affected the situation. The legislators of the various States have not seen fit to prescribe working conditions, hours of labor, or rates of pay, for the trackman. Here, if anywhere, the desire of the managing officials for freedom to deal with the men as individuals is most fully met, and what is the result? As one general manager has expressed it, "The work becomes more expensive and less efficient every year." Certainly "there's a reason" and it ought not to be so very hard to find.

A few years ago the term "railroad baron" was in common use and should have been, though, perhaps, not so intended, a most honorable designation, for who ever has given feudal history more than superficial study, knows that most of the barons were the best of the race of men existing in their time. But the counterpart of the baron was the retainer, the man who, depending on the executive ability of the baron to assure protection and sustenance for himself and his family, gave in return a lifetime of loyalty and labor. Without loyal retainers the baron could not exist. Life was short in those rough-and-ready times for the baron who could not command the services of a large and devoted following. The trouble with our "railroad barons" is that they have allowed the stewards or bookkeepers to dictate them out of their retainers by setting up a wrong standard of employment, a standard in which the unit is merely the bookkeeping one, "a name on the payroll" instead of the operating officers' standard of faithfulness and efficiency in service.

Give the roadmaster and even the section foreman the right to measure a man's worth and reward each man according to his worth in the service, instead of allowing the auditor to standardize marks on a pay sheet as worth a fixed price each, and there will be little trouble in finding for our railroad barons an army of faithful, efficient retainers in the maintenance department, who will relegate the present condition in the track service to a memory as of a nightmare, to be remembered only as a warning of things to be avoided.

LAYING SAND BAGS AND ANCHORING TRACK.

E. G. Lang, Roadmaster.

Where tracks are on river banks it is necessary to take soundings in the water at edge and out to channel of river, in order to determine the class of material to be dealt with.

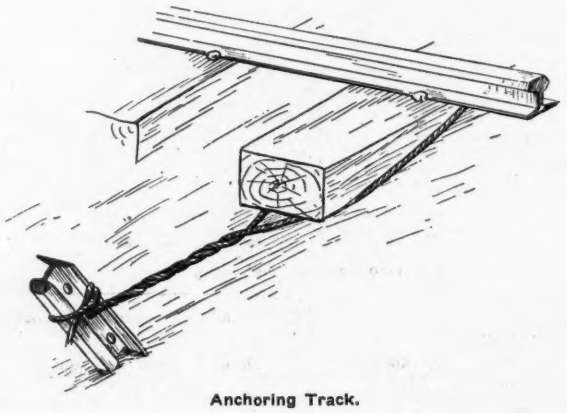
About the only effective protection against high river water, is boulders on a bank slope of 2 to 1. After placing large boulders on the 2 to 1 slope, the top should be leveled up with spauls, if not drift is liable to knock out the boulders.

The system of inspection is left entirely to the section foreman and roadmaster, as the channels of the creeks and rivers are continually changing. It is very important that all high water places be watched, and it is very easy for a man on the ground to discover immediate danger by watching the flow of the current and knowing the drainage area, keeping check on the extent of the rise in the creek. When water begins to reach the danger mark, he can readily estimate the extent of the rise ahead far enough to give advice and call the amount of help and material needed to make repairs and prevent washouts.

On my division I have become familiar with the drainage area of almost every creek, river and ravine, getting this information from the engineers. I, in turn, give this information to the section foremen. This is as important as giving the section foremen the degree of curves on their respective sections.

I have confined myself to the weather bureau for information in regard to high water in rivers, and I rely on the judgment of my section foreman, to keep in touch with different telegraph offices in regard to the amount of rainfall during each heavy rain. All such menaces as reservoirs and lakes should be carefully patrolled by watchmen, in touch with telephone service, during the rainy season. Every section house and roadmaster should have a telephone connecting direct with the dispatcher's office.

There are a number of ways to protect places liable to wash out. The quickest way is to use sand bags. Should there not be any sand available, crushed rock in sand bags is very effective when filled half full and laid flat on the ground with the tied ends upwards. Continue in this manner, placing the tied ends upwards, laying as shingles on the roof of a house.



Anchoring Track.

One sack in each place will carry the water. Sand bags should never be filled enough to make them round, but should be filled one-half to give a flat form.

In protecting banks with riprap, the filling should always be started at the foot of the embankment or placed where the water is washing, and the bank or cut should always be sloped before placing the rock. A great deal of economy in the use of riprap for immediate and preliminary precaution can be had by sloping the bank. Protecting the banks of lakes or rivers from sluffing on account of high wind and waves striking the banks, should be done by placing sand bags or riprap at water's edge, being careful not to get too much weight on any one place to break the foundation. In case of water rising, banks should be cut back with shovels in order to get a better foundation for more riprap or sand bags.

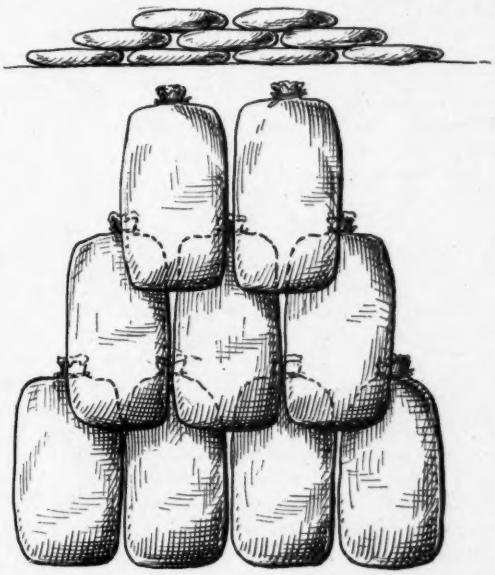
In the timbered country we sometimes have a combination of causes of a washout—drift practically damming up a stream and causing heavy water pressure. In some instances, drift will stop up the opening to bridges, which causes the approaches to wash out. In this case an engine with ropes to break the drift, is most effective. In some cases dynamite has been used very effectively.

A track can be held in place by staking on the up stream side every 15 or 30 feet, according to the amount of water

expected, with a five foot scrap rail driven into the embankment at a 25° angle and tied with old telegraph wire over tie and under rail. Bring the wire down the sides of the ties and twist it under at ends of ties as shown in sketch. Where track is in bottom land and is submerged with eddy water, it can be held in place very effectively when ballasted with earth, sand or gravel, with Bermuda grass, or rock crushed to pass through a 3-inch ring. I have made repairs to minor washouts for a distance of three miles, tamping up the track with sand bags, when water was from 6 inches to 2½ feet over rails.

In case of a light washout, Roger Ballast cars converted to side dumps, or center dumps with any kind of material available, are very effective for getting track back into service.

In heavy washouts, if bridge material and conditions permit —track men and bridge men can frame-bent a washout quicker than they can crib it. In some cases track can be cut down



Methods of Laying Bags of Sand. Bags Should Be Flat.

where not washed, and lowered gradually through a badly washed out place.

In case of washout the approach of bridges can sometimes be cribbed up. If there is any riprap available it can be used to make permanent repairs.

In cases of heavy washouts at bridges, about the quickest and most effective way is to frame-bent the opening; or if a pile-driver is available, construct a pile bridge. All B. & B. men should have information concerning their respective territories, and at all times have enough material to meet the emergency on their respective divisions.

In some climates we have occasionally what is commonly known as water spouts. Such extraordinary conditions have to be met in all localities. In such cases I would suggest for quick result, to call together three or more practicable men—roadmasters and bridge supervisors—to cope with the conditions.

The Chesapeake & Ohio has extended the Coal river district of the Huntington division from Helen, W. Va., to Sovereign, 5 miles.

The Chicago & NorthWestern, it is reported, has given a contract to Winston Brothers Co., Minneapolis, Minn., for the grading and bridge work on an eight-mile coal spur from Benid, Ill., south to Staunton, thence southwesterly into Madison county. The work is now under way.

The Colorado & Northern is projected between Hayden, Colo., and Casper, Wyo. Belgian and Paris capitalists, it is reported, will finance the project which includes the purchase of 30,000 acres of coal lands in Routt county. The line as planned will connect with the Denver & Salt Lake at Hayden, the Union Pacific at Wolcott and the Chicago & NorthWestern at Casper, Wyo.

The Dallas, Fairfield & Gulf has been incorporated in Texas with $105,000 capital and headquarters at Fairfield, to build from Dallas southeast via Ferris and Fairfield to Jewett, about 110 miles.

EXTRA GANGS A NECESSITY.

B. F. Gauldin, Roadmaster.

On account of the scarcity of good track foremen at the present time, I am in favor of doing heavy work on the track by extra gangs. Good foremen are becoming scarcer every year, and a roadmaster is fortunate in getting one who can attend to the detail work of a section properly, such as keeping up low joints, ordinary tie renewals, surfacing rough places, lining track where it has kicked out, etc.

In putting on an extra gang, we generally try to find one of the section foremen who is capable of handling a large gang, and who has had experience in renewing steel, ballasting or laying new track, and occasionally it is necessary to send off of the road for a good man.

If good experienced section foremen could be obtained, it would be cheaper to let the section men do their own work altogether, including heavy renewal work, such as renewing steel or ballast, or extending passing tracks or spurs, by working larger gangs and working two or three gangs together. Work done by section foremen would, I believe, stand up better, as every foreman will take pride in getting good work done on his section so he will not have to go over the same piece of track for some time to come, while extra gangs will as a rule work over the track as fast as they can so as to get through with the work.

Americans are keeping away from the track department of a railroad, as the wages are no inducement for them to enter that service, and foreigners are used as laborers. Possibly one foreman can be made from every five hundred employed, and he is not entirely reliable and could not handle large jobs. The majority of track foremen we have today are men of thirty-five years of age and upward, and good men are hard to secure at that. This condition necessitates extra gangs in charge of experienced men who can do the work, as they are as a rule not to be found on the section.

KEEPING DITCHES AND CULVERTS OPEN.

T. Hickey, Roadmaster.

One of the chief duties of track forces is to be prepared for high water trouble before it comes. Ditches should be kept in proper condition and should be made as large as conditions require at the different locations. All obstructions should be kept away from approaches to bridges and culverts to allow a free passage for water. Where there is any danger of erosion, embankments should be made secure by the placing of rip-rap stone.

I make it a point to know the conditions in time of high water at the different places on the division that I have charge of, either by personal observation or from the foremen, who are fully instructed to make inspection in time of high water, night or day, and make high water marks for further references. At such times foremen should be vigilant if there is a possibility of danger; they should find trouble and protect trains, and prevent accidents.

At night when water falls in larger or unusual quantities, the telegraph operator on duty is instructed to call the section foreman, who will get his men and make inspection; the foreman will wire, before commencing the inspection trip, that he is about to do so and will wire the conditions found after making the inspection trip.

During winter months where snow drifts in and fills the ditches, they are opened through the snow to the bottom to

allow an unobstructed passage for water in case of a thaw, otherwise the water is liable to flood the track and may cause a washout, or a sudden change in the temperature would cause the water to freeze on the track.

Heavy ice is removed from culverts and to a safe distance from the ends. Ice is also removed, or kept broken up, around the wooden trestle piles to prevent the displacement of the trestle, which would also affect the condition of the track. I have experienced trouble where track was lower at bridge approaches than the track on the bridges and where the water raised and run over the track, causing a washout. I had the approaches raised to a corresponding height with the track on the bridge, after which there was no further trouble.

To hold submerged track we have run cars loaded with ballast, coal, or steel rails onto the track and left them stand there until water subsided, with good effect. Methods may be used for quickly getting track into service after water has subsided, as conditions will permit; everything should be done as quickly as possible to restore track safe for service.

When indications warn of impending high water that may endanger track at certain locations, piles should be loaded, as well as timber that may be required. A pile driver should be in readiness, and it would be well to have at least fifteen or twenty cars loaded with ballast or cinders to be used for filling to rush to point of trouble on the shortest possible notice. A few minutes' delay may sometimes mean a great deal when water is first commencing or threatening to do damage.

If not very extensive, washouts can be taken care of by cribbing up with ties or timber, or both; usually there is some old bridge timber on hand which can be utilized for cribbing, the cribbing to remain until other permanent means are decided on.

SOME REASONS WHY PIECE WORK COULD NOT BE WORKED SUCCESSFULLY IN THE TRACK DEPARTMENT.

Thomas Cain, Foreman.

Piece work is most just and desirable in trades for which it is suited, but to the track man falls too great a variety of work to admit of piece rates, giving on every job uniform pay per amount of effort required for execution. While there may be a chance of earning too much on jobs proving unexpectedly easy, as often as a chance of earning too little on jobs proving unexpectedly difficult, the vital objection is that a piece rate varying from job to job would often be too intricate to be handled by the average section foreman. Too often we find a foreman who is a first-class railroad man, yet owing to a lack of education he is unable to keep his own reports and do his corresponding, and thus resorts to his wife's ability to keep such reports.

The theory might be advanced that this could be overcome by giving the foreman, say, three or four sections to look after. By this I mean giving him the use of a gasoline car and a clerk who would be able to stay with him all day, thereby doing away with two or three foremen. But even at this it would be an even break in the bargainings of different workmen.

Few men are sufficiently expert to bargain on an equality with a foreman, which would lead to no end in the amount of controversy that would arise, some being influenced by favor and others by fear, leading to dissatisfaction and the loss of the laborer. Then without a man to immediately take his place, where would the advantage be to the company?

Could track work be so divided as to allow a certain crew of men to do a certain kind of work and then another crew to do another kind of work, then it would be comparatively easy to submit a rate which would prove satisfactory. So long as the average crew has to be called upon to perform the hundred and one different jobs to be found in track, so long will it be impossible to establish a uniform piece-work rate. Take, for instance, a crew starting out on its inspection trip in the morning; after covering their entire route they start on their way back. Suppose it is shimming time, and they have found some places where such work needs to be done. Does it seem plausible that any piece rate might be established that would prove satisfactory to provide for a payment of shimming from, say, one-half inch to three inches and from merely shimming around the joint to half or the whole rail? Granting this could be done, could we still carry on the work? Say that several such places had been found ranging from one-half to one mile apart. How could a system of piece-work rates be provided to make up for the time spent in putting on and off of the car, gathering up tools, pumping, etc?

Again supposing there is snow shoveling to be done. Could it be possible to arrange a scale to provide for the amount of cubic feet of snow shoveled or the distance shoveled?

Or further supposing it is the time for renewing ties and on making the inspection trip you found the fence down in one or two places, would it be advisable to leave this work and hurry back to work of putting in ties because the rate was just a little in advance in the work of repairing a fence? In consideration of these and many others I could mention, I fail to see how any piece rate could be worked out to advantage to the employe or the employer.

There doubtless have been many cases in which, from slack foremanship, the previous speed was too slow for the pay, comparing the work of some section crews with that of others. But while there must always be in time work a risk of driving men too much or too little, the tendency of the workman's average speed, apart from his own will to settle at a point in proportion to the encouragement in his pay, will generally prevent the company from getting by any method for the same pay additional work from one already making proper exertion. Where the lines of separation are not clear or cannot be depended on there are sometimes attempts to diminish the total labor supply rather than to grade it.

And lastly, workmen naturally mistrust a change. They fear that the company designs to gain at their expense as well as gain by closer utilization of material used. If by chance a piece of work is found where he can increase his output materially, he realizes immediately he will be in danger from rate lowering of being expected soon to do the enlarged amount of work for the same pay he had before. This will inevitably lead to a slighting of work in some other class.

DITCHES OF SUFFICIENT SIZE TO PREVENT WASHOUTS.

R. O. Gillies, Roadmaster.

As "washouts" are very expensive propositions to cope with on a large railroad, care should be taken and arrangements made whereby they could be avoided if possible, as "an ounce of prevention is worth a pound of cure."

In order to prevent tracks from washing out it is the practice to tie the track with ordinary telegraph wire to trees and posts adjacent to the right-of-way, also to rip-rap the embankment to keep the ballast from washing out when the water recedes. Ditching is also done and openings made larger.

All section foremen on our line instructed to advise the roadmaster's office immediately after any high water, giving height of water and distance of water from base of rail and statement showing reason for the high water, and steps are taken to have the engineering department representatives go there and make an investigation as to cause and remedy; and where it is thought best, the remedy is applied.

In order to get track into service as quickly as possible after "wash-outs," a work train is started out and picks up all necessary section men and takes them to the scene; work train also takes what cinders are available at cinder pit.

Drift under bridges is watched carefully and removed as soon as possible after it forms there, to prevent the water from washing out the bridge.

Ditching is not very expensive, with proper tools to work with, and I believe it is advisable to do all the ditching possible in order to prevent high water, as it will cost more money in the end than it will to do the necessary ditching to prevent the high water.

STRUCTURES.

It is reported that about $2,000,000 will be spent in improvements to the union depot at Denver, Colo., and on the trackage and on new grounds for extension of the tracks. A. D. Parker, vice-president of the Colorado & Southern, and E. L. Brown, vice-president of the Denver & Rio Grande, are reported to have been appointed a committee to choose an architect for the reconstruction of the depot building. The tracks at the union depot will be raised five feet and passageways built under them.

The Railway Commissioners of Canada have authorized the Canadian Pacific to build a bridge over North river, Muskoka subdivision, Ontario division; also to build a bridge on Hamilton subdivision, Ontario division.

It is reported that the Lehigh Valley is asking for bids on four bridges totaling 1,000 tons.

The Oregon-Washington Railroad & Navigation Co. has announced that a new freight warehouse, team tracks, yards and bridge will be built at Tacoma, Wash., in the near future, although detailed plans have not yet been arranged.

The Pennsylvania Lines West have awarded contracts to Cuthbert Brothers, Pittsburgh, Pa., for the construction of a one and two story car machine shop at Conway, Pa. It will cost about $25,000.

The Seaboard Air Line, it is reported, has given a contract to C. V. York, Raleigh, N. C., to build a one-story brick freight house, 41 ft. x 211 ft. at Greenwood, S. C. The cost of the new structure will be about $16,000.

The Union Terminal Co., of Dallas, Tex., is to apply to the Texas railroad commission for permission to issue bonds for over $2,000,000 to be used in the construction of the proposed union terminal facilities at Dallas.

The Southern Pacific will soon award contracts for the erection of the new Arcade depot at Los Angeles, Cal. The building will be 580 ft. long and 70 ft. wide. The central section, 220 ft. long, will be 50 ft. high and of steel and brick construction. The wings on either side will be two stories high. It will cost approximately $850,000. Parkinson & Berbstrom, Security building, Los Angeles, are the architects.

Personals

T. B. Sumner has been appointed general roadmaster of the Atlanta, Birmingham & Atlantic Ry., office at Manchester, Ga. T. H. Dean has been appointed roadmaster at Nicholls, Ga. W. A. Walker has been appointed roadmaster at Ogelthorpe, Ga. E. E. Sharpe has been appointed supervisor at Talladega, Ga.

H. J. Wurtele, roadmaster of the Birmingham Southern R. R., has been transferred from Corey to Fairfield, Ala.

W. M. Carrell has been appointed acting roadmaster of the Canadian Northern Ry. at Humboldt, Sask.

G. M. Elliott, assistant roadmaster of the Canadian Northern Ontario Ry., has been transferred from Toronto to Beaverton, Ont.

W. W. Fail has been appointed acting supervisor of the Central of Georgia Ry. at Dothan, Ala., succeeding W. W. McDaniel.

E. W. Budd, roadmaster of the Chicago, Indianapolis & Louisville Ry., has been transferred from Bedford to Monon, Ind. I. M. Houston has been appointed roadmaster at Bedford, Ind., succeeding Mr. Budd.

C. Carr has been appointed roadmaster of the Chicago, Rock Island & Pacific Ry. at Cedar Rapids, Ia.

D. P. McCarthy has been appointed roadmaster of the Chicago, Milwaukee & St. Paul Ry. at Western Ave., Chicago, succeeding A. Schumacher.

F. Ivers, roadmaster of the Denver & Rio Grande R. R., has been transferred from Walsenburg to Cuchara Jct., Colo.

F. H. Bishop has been appointed roadmaster of the Dominion Atlantic Ry. at Kentville, N. S.

H. Laboursadiere has been appointed supervisor of track of the Grand Trunk Ry. at Pk. St. Charles, Que.

J. O'Keefe has been appointed assistant roadmaster of the Great Northern Ry. at Northport, Wash., succeeding L. Christenson.

W. H. Putcamp has been appointed assistant roadmaster of the Illinois Central R. R. at Carbondale, Ill. Thos. Carey has been appointed supervisor at Effingham, Ill., succeeding P. J. Nolan. D. T. Crocker has been appointed supervisor at Dyersburg, Tenn., succeeding F. G. Walters.

C. F. Tyson has been appointed roadmaster of the Kansas City Southern Ry. at Pittsburg, Kan., succeeding W. O'Connell.

HARRY HOMANS, Assistant Roadmaster, Maine Central R. R.

D. Oaks has been appointed supervisor of track of the Lehigh Valley R. R. at Delano, Pa., succeeding J. J. Hofelich.

R. R. Foster has been appointed roadmaster of the Live Oak, Perry & Gulf R. R., office at Live Oak, Fla., succeeding J. J. Jones.

Harry Homans has been appointed assistant roadmaster of the Maine Central R. R. at Lewiston, Me.

J. E. Johnstone has been appointed supervisor of track of the Minneapolis & St. Louis R. R. at Marshalltown, Ia., succeeding J. Laughlin.

H. M. Curtis, track supervisor of the New York, New Haven & Hartford R. R., has been transferred from Whitman to South Braintree, Mass. C. H. Rogers, track supervisor, has been transferred from Taunton to Middleboro, Mass., succeeding E. W. Bishop, transferred.

J. Brumfield has been appointed roadmaster of the Norfolk & Western Ry. at Jaeger, W. Va., succeeding R. F. Tavenor, transferred to Kenova, W. Va., where he succeeds L. Davis.

John Atleo has been appointed supervisor of the Northern Central Ry. at Parkton, Md., succeeding J. A. Hackenberg.

C. C. Blood, roadmaster of the Northern Pacific Ry., has been transferred from Sprague to Seattle, Wash. G. C. Chittenden has been appointed roadmaster at Sprague, Wash., succeeding Mr. Blood. Lee Barnes has been appointed assistant roadmaster at Minneapolis, Minn. S. D. Hill, assistant roadmaster, has been transferred from Seattle to Lester, Wash.

M. Duncan has been appointed roadmaster of the St. Louis & San Francisco R. R. at Francis, Okla., succeeding E. Sullivan.

J. J. Daily has been appointed roadmaster of the Oregon Short Line R. R., office at Kemmerer, Wyo., succeeding John McGreevy, resigned.

Wm. Wilson has been appointed roadmaster of the Oregon-Washington R. R. & Navigation Co., at Walla Walla, Wash., succeeding D. O'Tooele.

E. C. Finley, who has been appointed superintendent of maintenance of way of the San Antonio & Aransas Pass Ry., as noted in the May issue of *Railway Engineering*, was appointed resident engineer of the Mobile & Ohio R. R. in 1897. From 1899 to 1901 he was assistant engineer on the Southern Pacific R. R., and in the latter year he was appointed engineer of the Louisiana Purchase Exposition at St. Louis. From 1905 to 1907 he was engaged in general practice and as engineer of the Mississippi railroad commission. From 1907 to 1910 he was engaged in railroad contracting, and in 1910 was appointed supervisor of bridges and buildings of the Mobile & Ohio R. R. During 1911 and 1912 he was chief engineer of the Manufacturers Ry. of St. Louis, which position he held till his appointment as noted above.

Effective July 15, O. B. Lackey, formerly assistant engineer, was appointed assistant roadmaster of the Birmingham division of the Southern Ry., office at Birmingham, Ala. L. Sitton, formerly assistant engineer, has been appointed assistant roadmaster at Greenville, S. C.

C. Cole, roadmaster of the Southern Pacific Co., has been transferred from Santa Barbara to Surf, Cal. F. Reilly, roadmaster, has been transferred from Wells, Nev., to Montello, Cal.

Jose Gandara has been appointed roadmaster of the Southern Pacific R. R. of Mexico at Culiacon, Sin., Mex., succeeding R. A. Dorsey. E. B. Sloan has been appointed roadmaster at Acaponeta, Sinaloa, Mex., succeeding Mr. Gandara.

Michael O'Connor has been appointed roadmaster of the Toledo & Ohio Central Ry., at Columbus, O., succeeding F. J. Lee.

With The Manufacturers

A NEW METHOD FOR TAKING LEVELS.

It would seem that any simple device which would very materially aid in taking levels would have been discovered long ago. But this age seems to be one particularly selected for astounding developments.

The method described herein is not entirely new, although not known to more than one per cent of the engineers throughout the country, for the reason that there has never been on the market, or patented, any practical rod for the purpose. The Chicago Steel Tape Co. is about to put on the market, and is applying for patents on a rod, which, it is claimed, will revolutionize the method of taking levels for every purpose.

By a peculiar, although simple, arrangement of a leveling rod, the level instrument is made to assume the datum plane, thus making the readings of the rod the exact elevation of the spot on which the rod is held. This eliminates entirely, in the field or in the office, all computation, which has always been necessary in the common method of taking levels, and makes the columns for fore and back sights and instrument height, now common in all field level books, of no use whatever. The only columns necessary with this method are for stations and elevations, even for turning points.

The rod in many respects resembles the ordinary leveling rod. The method of extension can be similar to that of the Philadelphia rod, with one piece sliding on the other, but preferably that of the Chicago rod, which has the entire face on one plane. To any of these rods a short sliding piece is attached at the lower end, on which the entire rod is raised to the desired height. The face of the rod can be graduated in any of the customary ways, but the figures must increase downward instead of upward, and the unit figures must be interchangeable. Or the rod can have a sliding face, either by the use of a ribbon or other methods. Use can be made of a target the same as is customary at present.

The operation is much more simple than that in use at the present time. The rod described herein has been thoroughly tested for several months by an engineering department in one branch of the government of one of our largest cities and has received unlimited and unanimous commendation from the engineers connected with it.

TRACK SUPPLY ASSOCIATION.

The diagram herewith shows the arrangement of Track Supply Association exhibits, and the convention hall where the Roadmasters' and Maintenance of Way Association will hold its annual convention. Since publishing the list of exhibitors and members of the Track Supply Association in July, there has been added to this list the firm of C. H. Whall & Co., Boston, Mass.

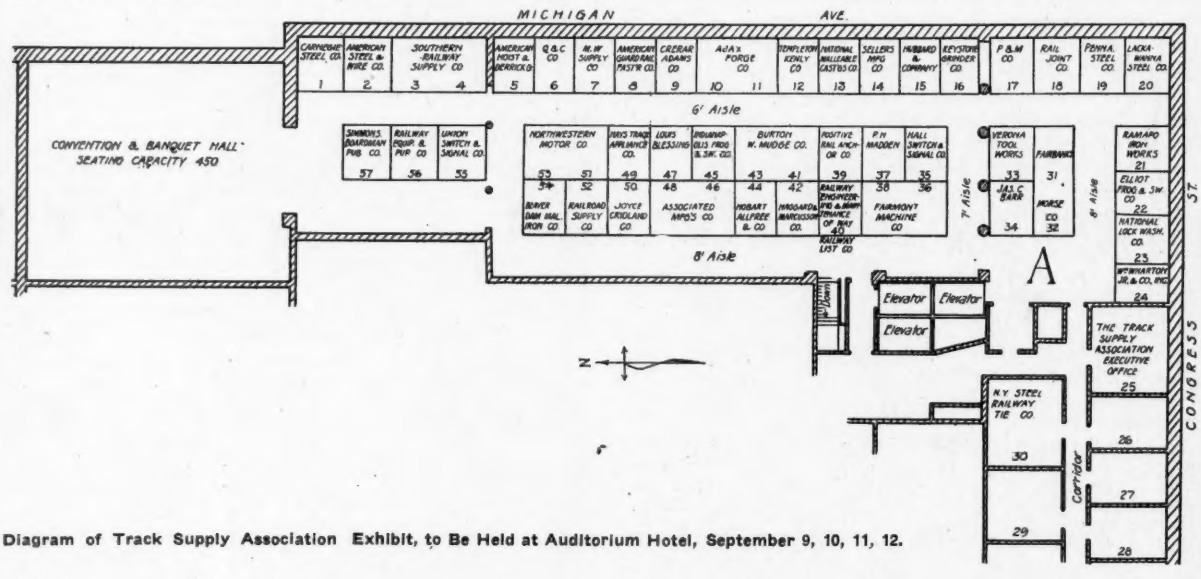


Diagram of Track Supply Association Exhibit, to Be Held at Auditorium Hotel, September 9, 10, 11, 12.

CHAIN BELT PAVING MIXER.

The Chain Belt paving mixer is well adapted to many classes of railway work. This mixer is of the same general design as the standard side discharge Chain Belt mixer. It has a chain belt drive, cast semi-steel bulge drum, chilled rollers with bronze bushings, all steel frame, etc.

This machine is especially designed for laying concrete pavements, and it can also be used for street and steam railway work for placing concrete between ties and all track purposes, and is well adapted for mixing concrete for bridge abutments, etc. It is provided with a reversible traction drive, so that the mixer can be moved forward or backward on its own power. The traction drive is fitted with a friction clutch. To move the machine ahead it is only necessary to thrown in the clutch, and it is stopped by throwing out the clutch. The traction drive is connected to both rear wheels, and is sufficiently powerful to propel the machine up an incline of 15 degrees. For street and steam railway work the paver can be fitted with standard gauge wheels.

Chain Belt Paving Mixer, With Distributing Boom.

No platforms or runways are required, and if the material is placed sufficiently close to the machine, it can be shoveled directly from the supply pile to the open end power loader bucket. The levers are so arranged that one man can operate the entire machine if necessary. The operator stands on a platform on one side of the machine, about thirty inches above the ground, and can operate the power loader, water tank, discharge and boom. This mixer is capable of turning out a batch of concrete in 45 seconds.

The Chain Belt street paver is equipped with a boom twenty feet long, and a delivery bucket. Contractors have found this the most economical method of spreading concrete, as it eliminates the use of wheelbarrows and carts.

The concrete is discharged from the mixer into the delivery bucket, which travels on a single boom. The boom can be swung at an angle of 180 degrees, and a distance of fifty feet can easily be taken care of. The boom bucket will hold a full batch of mixed concrete, and is provided with an automatic tripper, and the gate opens automatically. The same man who operates the mixer levers also controls the movements of the boom and bucket. Where desirable, a gravity swivel chute may be substituted for the distributing boom.

The Chain Belt street paver is made in three sizes—10, 15 and 23 feet, respectively. The No. 10 weighs 11,000 pounds, the No. 15 weighs 14,000 pounds, and the No. 23 weighs 17,000 pounds.

The mixer described is manufactured by the Chain Belt Co., Milwaukee, Wis.

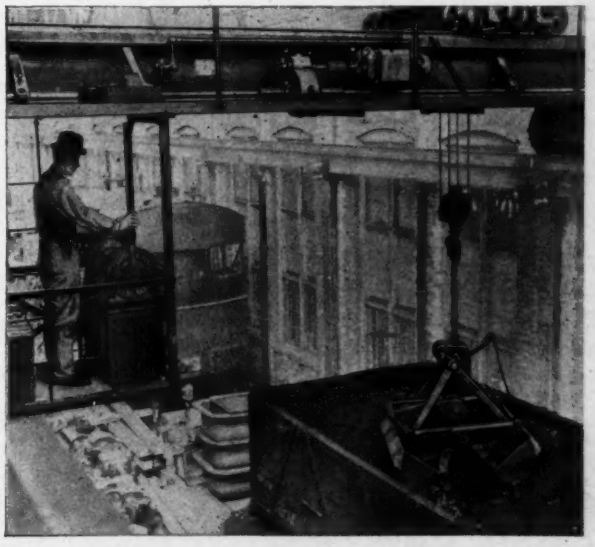
It is reported that the Lexington & Eastern is locating a 10-mile branch from Mason, Ky., up Mace's creek on the Letcher-Perry border to tap extensive coal and timber lands. It is understood that construction work on the branch will be started at once.

NEW GRAB BUCKET.

The grab bucket described herein was designed to comply with the following conditions: A crane handling a sand bucket in an extremely busy foundry needed rebuilding and it was stipulated that (1) the rebuilding of the crane must not interfere with its regular daily service; and (2) the changes must not impair the regular hook service of the crane.

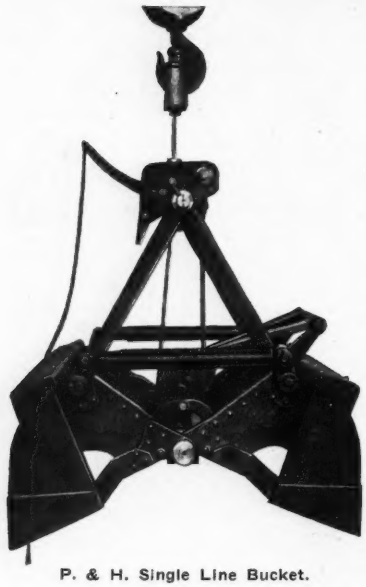
These conditions were satisfactorily solved by designing and constructing a special grab bucket exactly suited to the needs, and so arranged that the bucket could be readily attached or detached from the hook of any crane of sufficient capacity, no special hoisting apparatus being necessary.

The opening and closing of the ordinary grab bucket, commonly termed a two-line bucket, is accompanied by means of two separate hoisting cables attached to two distinct and separately operated hosting-drum mechanisms; by hauling on one of the cables the bucket is closed, and is then hoisted to the desired position when by transferring the weight of the bucket to the second cable and relieving the strain on the first one, the bucket opens by reason of the weight of certain moving parts of the bucket itself.



P. & H. Single Line Bucket Unloading Cars.

The "P & H" bucket distinctly differs from the above inasmuch as it dispenses with the necessity of the second hoisting cable, and its consequent hoisting mechanism, and is, therefore, justly called a one line bucket, although this line may consist of two parts of rope operating in unison and taking an equal strain.



P. & H. Single Line Bucket.

If no provision were made against it the opening and closing of a bucket of this type would produce a considerable shock. To overcome this undesirable feature the bucket is provided with pneumatic shock absorbers and the moving parts are designed to balance each other.

The bucket described herein is manufactured by the Pauling and Harnishfeger Co., Milwaukee, Wis., and is especially effective in digging molding pits, or unloading hard packed sand from cars.

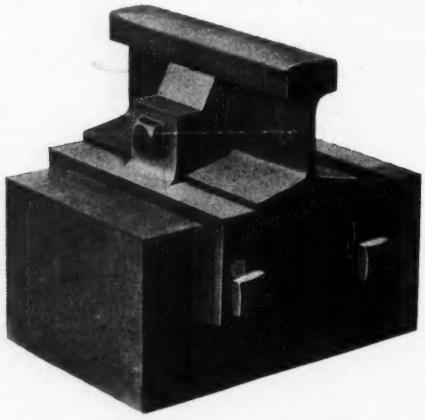
COMBINATION RAIL FASTENER.

A combined tie plate and rail fastening has recently been gotten out by the Railway Car Door Co., Peoples Gas Bldg., Chicago.

The illustration herewith shows the principal features of the device. The plate fits over the top of the tie and has bent down portions which are screwed to the sides of the tie by ordinary lag screws.

The only holes in the tie are the ones made by the lag screws in the side, there being no vertical holes to allow penetration of water into the tie and hasten decay. The wedge between the plate and the tie has a tendency to prevent splitting.

The base is made wide enough to distribute the weight over a large area to prevent cutting of the tie. The bottom is flat, but the plate cannot rattle as long as the lag screws retain their hold.



New Tie Plate and Rail Fastening.

It is claimed that this device is efficient as a tie plate, anti-creeper, rail fastener and tie protector.

HAND-POWER BENDERS FOR LARGE REINFORCING BARS.

A very powerful machine for bending reinforcing rods cold, operated by one man, has recently been placed on the market.

The machine is designed particularly to handle heavy stock and will bend 1¼ in. bars cold without any difficulty. Rounds and flats can also be bent on this machine, and by substituting higher dies, flat stock 4 in. wide or even wider can be handled successfully. The jaws or dies of the machine are so arranged that they can be easily set to suit various sizes of bars.

The power is obtained by a lever which is operated by a ratchet in combination with a small pinion. The latter engages a series of cogs on the edge of the main frame of the machine, the gearing being on a ratio of about 8 to 1.

This machine is known as the No. 5 angle bender and is the outgrowth of long experience of the manufacturers in making bending tools of all kinds. The machine may be purchased complete with or without a cast iron stand.

Reinforcement Bar Bending Machine.

The approximate weight of the No. 5 angle bender is 268 lbs., without stand. The stand weighs about 160 lbs.

This bender, as well as a complete line of ring benders, eye benders, and angle benders, is being marketed by the Wallace Supply Co., 114 North Jefferson St., Chicago, and 2316 Woolworth Bldg., New York City.

The Mansfield Transportation Co., operating a line from Mansfield, La., to the Sabine river, will extend its line to Neighborton, about 10 miles, to take care of the business created by the opening up of a new oil field in De Soto parish.

The Motley County has been incorporated in Texas with $100,000 capital and headquarters at Matador. The plans call for building from a point 3½ miles north of Roaring Springs, on the Quanah, Acme & Pacific, north through the counties of Motley, Hall and Childress, to Memphis, on the Fort Worth & Denver City.

It is reported that the right of way is being secured for the Newton, Kansas & Nebraska, which proposes to build out of Newton, Kansas, via Geneseo, Canton and Roxbury to Salina.

New Literature

A booklet containing parts IV, V and VI of the treatise, "Some Facts About Treating Railroad Ties," has been issued by the W. F. Goltra Tie Company, Cleveland, Ohio. Part IV contains a reprint of a paper "Comparison of Zinc Chloride and Coal-tar Creosote for Preserving Cross Ties" (which was given before the Wood Preservers' Association by Howard T. Weiss), together with a discussion of same by W. F. Goltra. The other parts contain a "History of Wood Preservation," and a list of wood preserving plants in the United States, with other miscellaneous data.

* * *

The Chicago Pneumatic Tool Company has issued an attractive booklet describing and illustrating the Rockford motor car, and giving some "facts" regarding its use. A number of letters from users are printed, and also some figures on cost of operation of several of these cars. The latter half of the catalogue contains a description of the different construction details of the car, well illustrated, and also specifications for Rockfords cars No. 2, No. 4 and No. 5. On pages 25 and 26 is given a description of the No. 1, electric signal bonding outfit, a new product. Every man interested in railway motor cars should have one of these catalogues.

* * *

The General Railway Signal Company, Rochester, N. Y., has recently issued Bulletin 129, for inserting into the standard loose leaf catalogue binder, describing the G. R. S. Mechanical Dwarf Signal, designed to comply with R. S. A. standards. This company has also issued an attractive booklet describing and illustrating the G. R. S. Train Dispatchers' Telephone Selector System. The details of this equipment are described and illustrated. A typical wiring diagram is shown at the back of the catalogue.

* * *

The Link Belt Company, Chicago, has issued Book No. 79, on Belt Conveyors. There are 72 pages and a large number of illustrations of the many types of conveyors manufactured by this company.

* * *

A most elaborate catalogue has recently been issued by the P. & M. Company, Chicago, entitled "Interesting Installations of P. & M. Rail Anti-Creepers." The book is larger than most catalogues, which makes it possible to use some very large reproductions of photographs of P. & M. anti-creeper installations. The illustrations are of unusual excellence. The typography and paper used make possible a most attractive catalogue.

Industrial Notes

JAS. B. STRONG.

In honor of Jas. B. Strong, assistant general manager of the Ramapo Iron Works, who has completed ten years of active work with that company, a dinner was tendered July 19th at Hotel Knickerbocker, New York City, by L. G. Murphy, designing engineer of the Boston & Albany; W. B. Knight, division engineer of the Boston & Albany; C. J. Coon, engineer of the Grand Central Terminal; Theo. F. Lange, assistant engineer of the Grand Central Terminal; P. W. Vallely, office engineer of the Brooklyn Water Works, and C. S. Klumpp, superintendent maintenance of way and structures of the Hudson & Manhattan.

The following gentlemen of the Ramapo Iron Works also attended the dinner: J. Edgar Davidson, vice-president; George W. Conklin, cashier; Thos. M. Hopper, chief engineer; Geo. E. Haring, superintendent, and W. C. Kidd, representative.

Mr. Strong has occupied various positions with the company during the ten years of service, but for the past four years

J. B. STRONG, Assistant General Manager, Ramapo Iron Works.

has most efficiently performed executive duties as assistant general manager. His ability is of the highest order and is appreciated by all with whom he comes in contact.

H. H. Althouse, who recently resigned as chief engineer of the Erie, has opened an office for consulting practice at 172 Fulton street, New York city. He will specialize in railroad work, grade crossing elimination and coal and ore handling machinery.

W. E. Jenkinson has been appointed railroad representative for S. F. Bowser & Co., Inc., covering that territory vacated by E. F. G. Meisinger. In addition he will take over the Southwestern and Pacific Coast territory. He will cover the states from Texas to Oregon.

The Canadian General Electric Co., Ltd., which owns and controls as subsidiary companies the Canada Foundry Co., Ltd., and the Canadian Allis-Chalmers, has decided to consolidate the selling organizations of the two latter companies, dropping the selling organizations of both companies under the name of Canadian Allis-Chalmers, Ltd. Hereafter all sales of electrical apparatus and supplies will be in the name of the Canada General Electric Co., Ltd., and all general engineering contracts and sales of mechanical appliances in the name of Canadian Allis-Chalmers, Ltd.

The Compressed Gas Manufacturers' Association was organized in New York, March 21, 1913, by firms manufacturing and dealing in oxygen, acetylene, carbonic dioxide, and other gases.

J. G. Seyfried, assistant to the chief engineer of the Grand Trunk, at Montreal, Que., has resigned to accept the position of engineer for the bridge department of the Canada Foundry Co., Ltd., Toronto, Ont.

The Isthmian Canal Commission will, until July 9, receive bids on miscellaneous supplies, including switch stands, tie plates, track bolts, track spikes, valves, etc.

The Protectors Paint Co., of Philadelphia, has taken the railway selling agency for the products of the Barber Asphalt Paving Co.

Judge Snediker, on June 23, appointed Charles L. Harrison receiver and H. M. Estabrook co-receiver for the Barney & Smith Car Co., Dayton, O. Mr. Estabrook is president of the company. The receivers were appointed on the application of Joseph Brothers & Co., Cincinnati, O., creditors to the extent of $11,139. E. F. Platt, a stockholder of the Barney & Smith company, gave out a statement that the company was perfectly solvent and that the trouble had been caused by the recent floods.

Recent Engineering and Maintenance of Way Patents

DIVERTIBLE HOPPER DUMP CAR.

1,063,955—A. Campbell, assignor to Enterprise Railway Equipment Co., Chicago, Ill.

The combination of a car body having a hopper located below the floor level of the car and provided with door openings arranged on opposite sides thereof, hinged doors for closing the openings and a hinged false door located within the hopper and adapted to close one of the openings to thereby cause the material to pass out of the other door opening.

RAIL JOINT.

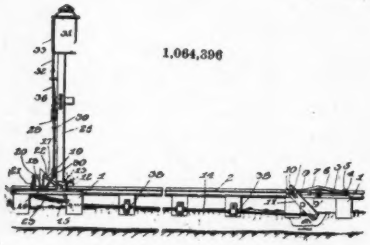
1,064,155—Frank W. Morse, Los Angeles, Cal.

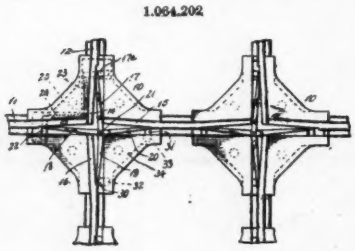
A rail joint chair, comprising two like sections, each consisting of a base portion having an obliquely projecting tongue and a corresponding slot adjacent the tongue, the tongue of one section adapted to lie in the slot of the other section, each of the sections including rail base engaging members, and removable means passing through the members for "locking" the members together, and an auxiliary locking means for locking the members together, the auxiliary locking means including a bendable element on one member for engaging a notch on the tongue of the other member to prevent movement of the tongues in their slots.

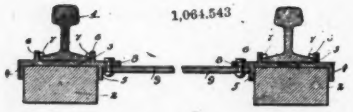
RAILWAY CROSSING.

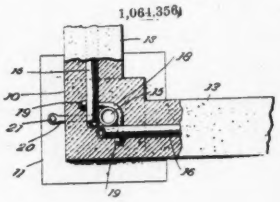
1,064,202—G. E. Fletcher, Anaheim, Cal.

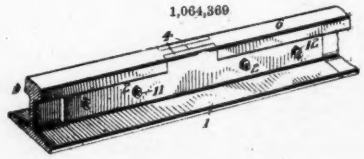
A railroad crossing comprising a base adapted to receive the head portions of the rails meeting at the crossing, crossing points fitting against the rails, some of the points having transverse bars arranged below the heads of the rail, springs connected with the bars

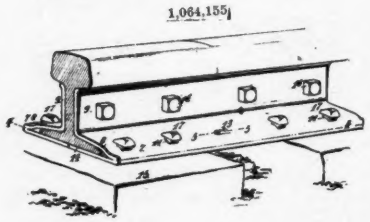


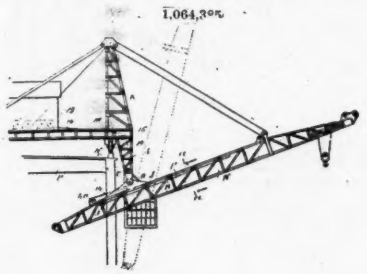


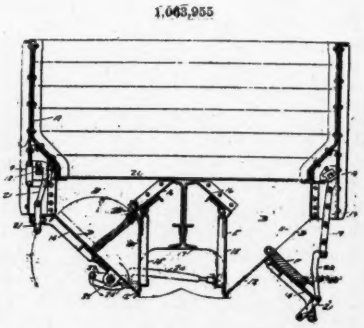












tending to force the points away from the rails, a pivot pin connecting the inner ends of the points, the points also having dowel pins projecting therefrom, some of the points also having pivot projections and being provided at their inner ends with sockets for receiving the dowel pins.

CONCRETE POST.

1,064,356—T. A. McQuirk, Tonkawa, Okla.

A post including a vertical core L-shaped in section, a pair of diagonal brace members also L-shaped in section and bearing against the outer faces of the core and extending outwardly and downwardly from the angular edge thereof, a tie bolt bearing transversely across the core and extending over the edges of its angularly disposed sides, the ends of the tie bolt being angularly directed and passed through those sides of the brace members bearing against the sides of the core, the angularly directed ends bearing against the edges of the core, nuts threaded upon the ends of the tie bolt and bearing against the inner faces of those sides of the brace members through which the tie bolt passes, and an integrally formed envelop of concrete surrounding the core and braces.

RAIL JOINT.

1,064,368—E. R. Orbin, Duquesne, Pa.

A rail joint comprising the combination with a pair of rails, each having the base at one end cut away to the lower terminus of the web and its head at the same end cut away at each side to provide that portion of the head of the same thickness as that of the web, the cut away portion of the head being of less length than the cut away portion of the base, the cut away end of one rail opposing the cut away end of the other rail, a chair including a base plate of the same contour as the base of a rail, the base plate interposed between and flush with the base of the rail and further forming a continuation of said bases, said chair further including vertically disposed spaced integral splice bars providing in connection with the plate a pocket having its bottom extending in the same longitudinal plane throughout and against which abut the bottom termini of the webs of the rails at the cut away ends thereof, filling members carried centrally of the splice bars extending in the cut away portions of the heads and flush with and forming continuations of these latter, and means extending through the splice bars and webs of the rails for securing the chair in position.

FREIGHT CRANE.

1,064,385—Harry Sawyer, Muskegon, Mich.

In an apparatus for handling freight, the combination with a traveling crane, of a boom pivotally mounted thereon and suspended therefrom and below the same, the inner end of the boom when in horizontal position for use extending inwardly inside of the crane structure, and means for shifting the boom endwise with reference to its pivotal connection to the crane and without interfering with its rocking or swinging movement.

AUTOMATIC SIGNAL.

1,064,396—D. J. Taylor, Tallassee, Ala.

A signaling system, comprising a supporting base, bearings carried by the base, a plural armed crank shaft journaled in the bearings, an upright supported by said base, a lamp container supported on the upper end of the upright, a shutter slidably mounted on the lamp container spring means constantly tending to move the shutter to closed positions, a counterbalanced semaphore arm pivoted on the upright, a connection between the shutter and the arm whereby the spring closing means of the shutter will normally hold the semaphore arm in non-signaling position, connections between one arm of the crank shaft and the semaphore arm, means actuated by the passing of a train to turn the crank shaft and move the semaphore arm to signaling position and the shutter to open position, a standard pivoted to the base and provided with a catch adapted to engage one arm of the crank shaft when the latter has been oscillated to dispose the semaphore arm in signaling position and further adapted to be thrown out of engagement with the crank shaft by a passing train, a lateral arm on the standard, a spring coacting between the arm and the base to normally hold the standard in active position and means for counter-turning the crank shaft when the catch is released.

TRACK SUPPORT.

1,064,543—Joseph Rogers, North Vernon, Ind.

The herein described construction of rail support, including a pair of spaced longitudinally extending wooden sleepers, a place arranged upon the top of each of the sleepers, each of the plates having angular sides which are adapted to engage with the opposite side faces of the sleepers, the plates adjacent their longitudinal edges having each a pair of malleable ribs extending the entire length of the plates and spaced to receive the rails therebetween, the ribs being slitted to provide fingers which are bent over the opposite longitudinal edges of the base flanges of the rails, the plates being extended beyond their inner flanges, the extending portion being provided with a plurality of spaced openings, spacing rods arranged beneath the projecting edges of the base and contacting with the inner side flanges provided by the plates, and securing elements passing through the openings in the plate extensions and through similar openings in the spacing member.

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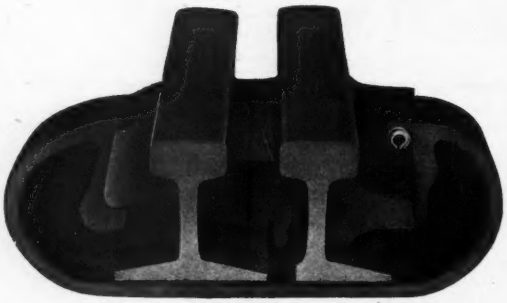

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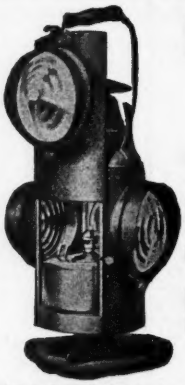

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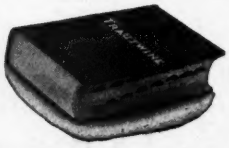

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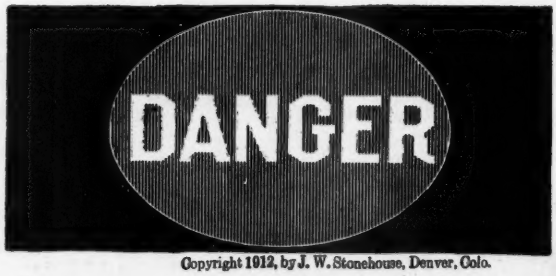

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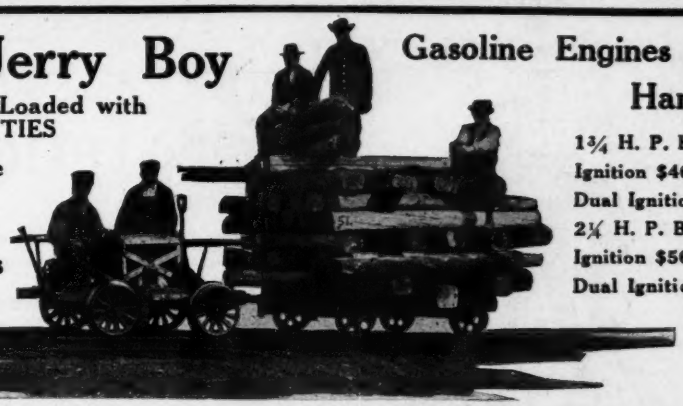

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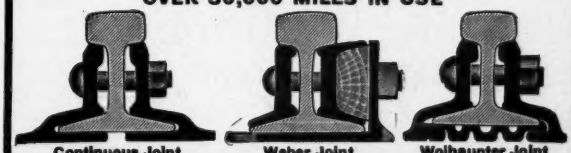

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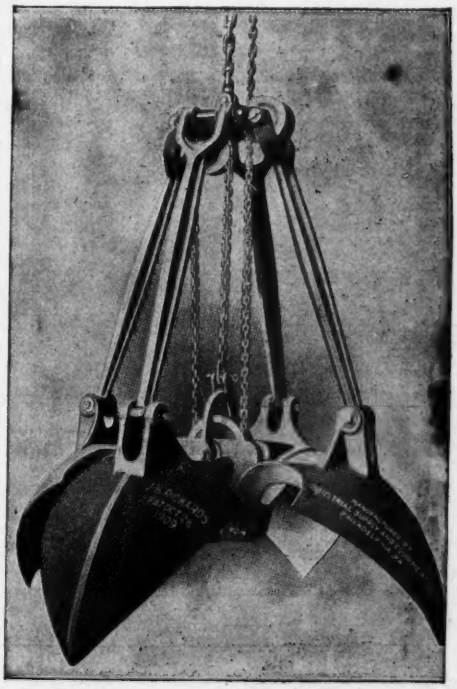

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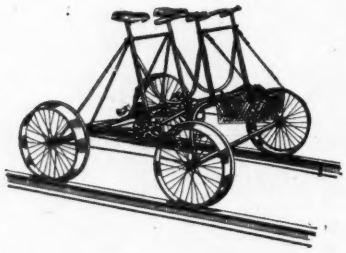

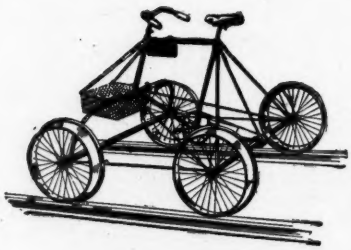

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United Electric Apparatus Co., Boston, Mass.

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Asbestos Sheathing.
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U. S. Light & Heating Co., New York.
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U. S. Light & Heating Co., New York.
Waterbury Battery Co., Waterbury, Conn.

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U. S. Light & Heating Co., New York.
Waterbury Battery Co., Waterbury, Conn.

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United Electric Apparatus Co., Boston, Mass.

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Gray, Peter, & Sons, Boston.

Bridge Paint.
Dixon, Jos., Crucible Co., Jersey City, N. J.

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Buckets, Dump.
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Williams, G. H., Co., Cleveland, O.

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Industrial Supply & Equipment Co., Philadelphia, Pa.
Williams, G. H., Co., Cleveland, O.

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Southern Railway Supply Co., St. Louis, Mo.

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Calumet Supply Mfg. Co., Harvey, Ill.

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Richards-Wilcox Mfg. Co., Aurora, Ill.

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Frog, Switch & Mfg. Co., Carlisle, Pa.
Indianapolis Switch & Frog Co., Springfield, O.
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Concrete Form & Engine Co., Detroit, Mich.
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Kalamazoo Railway Supply Co., Kalamazoo, Mich.

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Coe's Wrench Co., Worcester, Mass.

Zincs.
Edison, Thos. A., Inc., Orange, N. J.

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New Type Gordon RSA Cell

The specifications of the Railway Signal Association have been *greatly* exceeded in the latest development of the GORDON CELL, and you ought to know all about it.

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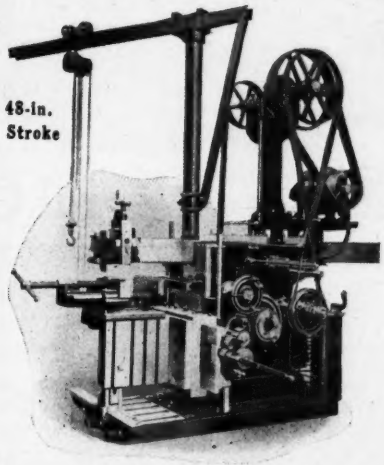
A Machine for the ENGINEERING Department



MORTON SPECIAL DRAW CUT FROG AND SWITCH SHAPER

IT is BUILT ESPECIALLY FOR THE WORK and has a SPECIAL HEAVY VISE for HOLDING RAILS FOR NOTCHING.

The STRONGEST, Most POWERFUL and EFFICIENT SHAPER BUILT.

Some of the large Manufacturers of Frogs and Crossings have from TWO to SIX of these machines in operation.

The railways which operate the largest frog and crossing plants have found that the work of these shapers is such as to make them indispensable.

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Have pleasing appearance, long life, low maintenance cost.
Will not rot, burst or burn.
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Need no expansion joint.
Are built entirely of steel.
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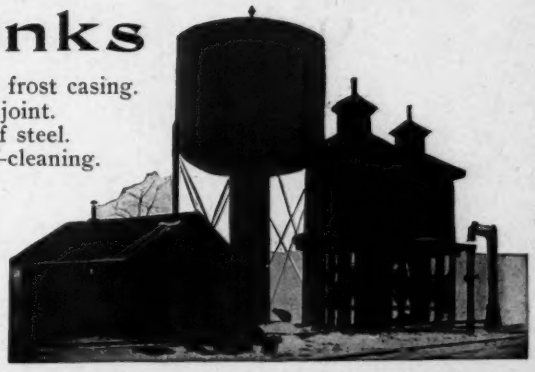
Cost about same as wooden tanks.

Write for plans, specifications and prices before placing your order. Descriptive catalogue No. 14 ready for distribution.



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Dallas, Texas
Greenville, Pa.

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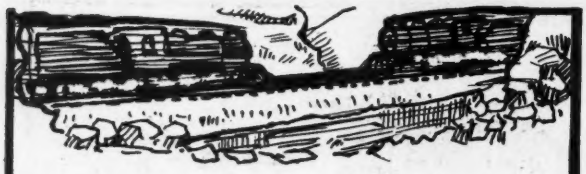

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¶ You know and we know that a Railroad is dependent on SOME RELAY in its signal service.

¶ And in just so far as the Relay performs the service for which it is bought, lies the dependability of your Block System.

Ziegler Relays

Are the Carefully Built Relays

and we are most particular that every Ziegler manufactured by us shall come to you carrying the accuracies of a Swiss Watch—that you may depend upon it absolutely. ¶

That's One Reason Why The Railway Signal Association Approves Our Apparatus!

¶ But there are other reasons, given you upon request.

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are equipped with the Kalamazoo Improved Reinforced Pressed Steel Wheel, giving 50 to 100 per cent greater wear than any other wheel of similar design or weight on the market. The car has stout gallows frame, thoroughly trussed, has taper wheel and pinion fits on axles, machine cut gears, flexible steady box and double acting brake.

16 Different Styles, Standard or Special

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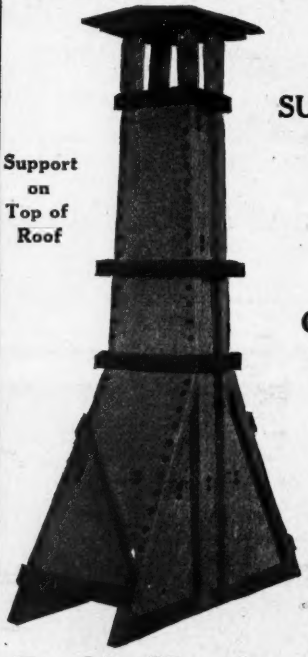
Kalamazoo, Mich.

Western Representative: Universal Railway Supply Co., Chicago

The FRANKLIN
ASBESTOS SMOKE JACK



Support on Top of Roof

ASBESTOS RAILWAY SUPPLIES, EVERY DESCRIPTION

ASBESTOS "CENTURY" SHINGLES

CORRUGATED SHEATHING

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Requires no paint. No rust. Everlasting and fireproof.

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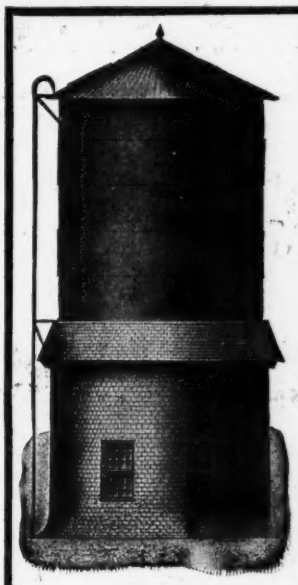
The Frog, Switch & Mfg. Co.
Carlisle ESTABLISHED 1881 Penna.



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CLEAR WATER

PURE WATER

CONTINUOUS SOFTENER
SOFTENERS
CONTINUOUS INTERMITTENT

FILTERS
PRESSURE GRAVITY

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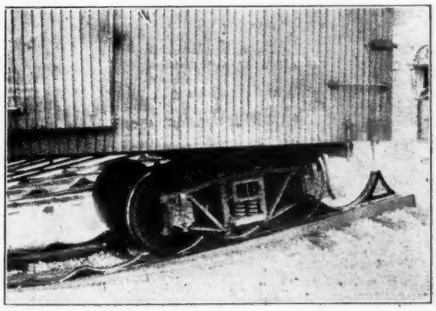
PITTSBURGH
KANSAS CITY CHICAGO
E-1



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Made possible by the construction and which is an exclusive feature of

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We have records of service tests to prove our claims—we install them subject to approval.

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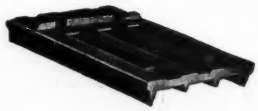
TIE PLATES AND SPIKES

GOLDIE PLATE

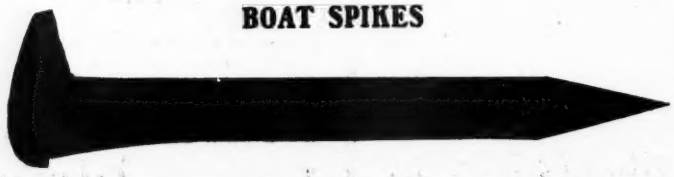


DILWORTH FLANGE PLATE

HARRIMAN PLATE

Standard and Special Railroad Spikes

BOAT SPIKES



Goldie Perfect Spikes a Specialty

All spikes are shipped in steel hooped kegs

THE Merit of "Indianapolis" Products appeal to the discriminating *Engineer* and *Roaaway Official*, who is progressive, practical and recognizes the value of Final efficiency and economy rather than low first cost with excessive maintenance and interrupted operating schedule.

He wants to know that all

Materials are strictly and absolutely first quality throughout.

Nothing but first quality rails and fittings go into any part of our product.

Nothing but American "**Stag**" Brand of manganese (the most dependable and serviceable metal of its kind yet produced) is used in our manganese work and in combination with scientific designing and liberal sections with a maximum safety factor—

Nothing is better (no exceptions).

He wants to know that

Workmanship and Methods are confined to the best modern practices only.

Our works are located at Springfield, Ohio.

We have every modern and improved facility for the most economical production of strictly High Class Product.

But employ no practices or methods to lessen the cost of production that are in any way detrimental to the steel or other material.

All rails are drilled—never punched.

All bolted structures are UNIT DRILLED and bolts a driving fit.

All rivets are compression driven—70 tons maximum pressure.

All manganese is accurately fitted and ground at a low temperature.

Result—Costs some more—worth much more.

He wants to know that

Design embodies strength and endurance and eliminates weakness and failures.

"Conservation of Energy" is a science which applied to Track and Rolling Stock has done more than any other one thing to bring into favor and recognition the "**Indianapolis**" Designs and their adoption by the leading and best roads in the country.

Our designs are the results of our own experience and observation together with a composite of suggestions of the most able Engineers and track men.

Designs that favor and protect both the structure and rolling stock.

Indianapolis built up designs of Regular Construction are reinforced and self-contained, prolong the life of the work.

Indianapolis R-N-R Designs of Manganese Frogs and Crossings have revolutionized maintenance and when introduced were a radical departure from any known practice, yet have been freely adopted and are extensively in use on nearly all roads of importance where purchases are not restricted.

Indianapolis R-N-R Designs have features of exclusive merit not found in any others.

Indianapolis Manganese Designs of Insert Special Work, were the first to feature the renewal of rail parts without removing from the track for repairs.

He wants to know

where to get what he needs.

It is made at

Springfield, Ohio.